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ERRATA.

Page	line	
3	11	for <i>controverfy</i> read <i>controverſy</i> .
4	22	after <i>facts</i> put a comma.
9	20	for <i>thoroughly</i> read <i>throughly</i> .
16	1	for ἐμοι read ἐμοί.
23	36 & 38	for <i>acknowlege</i> read <i>acknowledge</i> .
24	37	after <i>ſay</i> put ! inſtead of ?
29	4	for <i>was</i> read <i>were</i> .
30	18	twice, for <i>was</i> read <i>were</i> .
31	10 & 19	for <i>was</i> read <i>were</i> .

THE
NATURAL HISTORY
OF THE
HUMAN TEETH:

EXPLAINING THEIR
STRUCTURE, USE, FORMATION,
GROWTH, AND DISEASES.

ILLUSTRATED WITH COPPER-PLATES.

By JOHN HUNTER, F.R.S.

And Surgeon to St. GEORGE'S Hospital.

L O N D O N,

Printed for J. JOHNSON, N° 72. St. Paul's Church-yard.

MDCCLXXI.

A D V E R T I S E M E N T.

MOST of the Observations contained in the following Treatise were made by the Author before the Year 1755; and the Substance of them constantly demonstrated after that Period, in Dr. Hunter's Course of Anatomical Lectures. The Figures were drawn by Mr. Rymfdyk, under the Author's Direction, and engraved by Mess. Strange, Grignion, Ryland, and others.

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E R R A T A.

Page 28. l. 18. for *Theroide* read *Thyroide*.

38. l. 2. for *mal* read *Animal*.

117. l. 14. dele 10.

OF THE
U P P E R - J A W.

BEFORE we enter into a description of the Teeth themselves, it will be necessary to give an account of the Upper and Lower Jaw-bones, in which they are inserted; insisting minutely on those parts which are connected with the Teeth, or serve for their motion and action, and passing over the others slightly.

The Upper-Jaw is composed of two bones, which generally remain distinct through life. They are very irregular at their posterior and upper parts, sending upwards and backwards a great many processes, that are connected with the bones of the Face and Skull *. The lower and anterior parts of the Upper-Jaw are more uniform, making a kind of a circular sweep from side to side, the convexity of which is turned forwards; the lower part terminates in a thick edge, full

* Vide Plate III. Fig. 1st and 2d. A A.

of sockets for the Teeth. This edge is called in each bone the Alveolar Process*. Behind the Alveolar Processes there are two horizontal lamellæ, which uniting together, form part of the roof of the Mouth, which is the partition between the Mouth and the Nose†.

This plate, or partition, is situated about half an inch higher than the lower edge of the Alveolar Process; and this gives the roof of the Mouth a considerable hollowness.

The use of the Upper-Jaw is to form part of the Parietes of the Mouth, Nose, and Orbits; to give a basis, or supply the Alveolar Process, for the superior row of Teeth, and to counteract the Lower Jaw; but it has no motion itself upon the bones of the Head and Face.

* Vide Plate I. Fig. 1. *a, b, c, d.*

† Vide Plate I. Fig. 1. *e, e.*

OF THE
L O W E R - J A W.

AS the Lower-Jaw is extremely moveable, and its motion is indispensably necessary in all the various operations of the Teeth, it requires to be more particularly described. It is much more simple in its form than the Upper, having fewer processes, and these not so irregular. Its anterior circular part is placed directly under that of the Upper-Jaw; but its other parts extend farther backwards*.

This Jaw is at first composed of two distinct bones†; but these, soon after birth, unite into one, at the middle of the chin. This union is called the Symphysis of the Jaw. Upon the upper edge of the body of the bone is placed the Alveolar Process, a good deal similar to that of the Upper-Jaw. The Alveolar Process extends all round the upper part of the bone, from the Coronoide Process of one side, to that of the other‡. In both Jaws they are every where relatively propor-

* Vide Plate III. Fig. 1 and 2.

† Vide Plate VIII. Fig. 1, 4, and 6.

‡ Vide Plate I. Fig. 2.

tional to the Teeth ; being thicker behind, where the Teeth are larger, and more irregular, upon account of the more numerous fangs inserted into them. The Teeth that are situated backwards, in the Upper-Jaw, have more fangs than those that correspond with them in the lower, and the sockets are accordingly more irregular. The Alveolar Process of the Upper-Jaw, is a section of a larger circle than that of the lower, especially when the Teeth are in the sockets. This arises chiefly from the anterior Teeth in the Upper-Jaw being broader and flatter than those in the Lower*. The posterior part of the bone on each side rises almost perpendicularly, and terminates above in two processes†; the anterior of which is the highest, is thin and pointed, and is called the Coronoide Process‡. The anterior edge of this process forms a ridge, which goes obliquely downward and forward on the Jaw, upon the outside of the posterior sockets§. To this process the Temporal Muscle is attached ; and as it rises above the center of motion, that Muscle acts with nearly equal advantage in all the different situations of the Jaw.

The Posterior Process, which is made for a moveable articulation with the head, runs upward, and a

* Vide Plates I. and III.

† Vide Plate III. Fig. 2. e ; and Plate IV. Fig. 2.

‡ Vide Plate IV. ii.

§ Vide Plate IV. Fig. 2. B.

little backward ; is narrower, thicker, and shorter, than the anterior ; and terminates in an oblong rounded head, or Condyle *, whose longest axis is nearly transverse. The Condyle is bended a little forward ; is rounded, or convex, from the fore to the back part ; and likewise a little rounded from one end to the other, or from right to left. Its external end is turned a little forward, and its internal a little backward ; so that the axis of the two Condyles are neither in the same straight line, nor parallel to each other ; but the axis of each Condyle, if continued backwards, would meet, and form an angle of about one hundred and forty-six degrees ; and lines drawn from the Symphysis of the Chin, to the middle of the Condyle, would intersect their longest axis, at nearly right angles †. There are, however, some exceptions ; for in a Lower-Jaw, of which I have a drawing, the angle formed by the supposed continuation of the two axes, instead of being an angle of one hundred and forty-six degrees, is of one hundred and ten only. The Lower-Jaw serves for a base to support the Teeth in the Alveolar Process, during their action on those of the Upper-Jaw in mastication ; and to give origin to some muscles that belong to other parts.

* Vide Plate IV. Fig. II. E.

† Vide Plate I. Fig. 2. or Plate IV. Fig. 2.

OF THE
ALVEOLAR PROCESSES.

THE Alveolar Processes are composed of two thin bony plates, one external *, and the other internal †. These two plates are at a greater distance from each other at their posterior ends, than at the anterior, or middle part of the Jaw. They are united together by thin bony partitions going across, which divide the processes at the anterior part, into just as many distinct sockets as there are Teeth ‡; but at the posterior part, where the Teeth have more than one root or fang, there are distinct cells, or sockets, for every root §. These transverse partitions are more protuberant than the Alveolar Plates; and thus add laterally to the depth of the Cells, particularly at the anterior part of the Jaw. At each partition, the external plate of the Alveolar Process is depressed, and forming furrows, or a fluting || rounds the cells, or

* Vide Plate I. Fig. 1. *a, a, a, a, a.*

† Vide Plate I. Fig. 1. *b, b, b.*

‡ Vide Plate I. Fig. 1. *c, c,* and Fig. 2. *a.*

§ Vide Plate I. Fig. 1. *d, d.* and Fig. 2. *b, c.*

|| Vide Plate III. Fig. 2. *FFFF.*

cavities, for the roots of the Teeth. This is observable in the whole length of the Alveolar Process of the Upper-Jaw; and in the fore-part particularly of the Lower-Jaw. The Alveolar Processes of each Jaw, form about one half of a circular, or rather of an elliptical* figure; and at the fore-part in the Lower-Jaw they are perpendicular, but project inwards at the posterior part, and describe a smaller circle than the body of the bone upon which they stand †; as we shall observe more particularly hereafter, when we come to treat of the Jaws of Old People.

The Alveolar Processes of both Jaws should rather be considered as belonging to the Teeth, than as parts of the Jaws; for they begin to be formed with the Teeth, keep pace with them in their growth, and decay, and intirely disappear, when the Teeth fall; so that, if we had no Teeth, it is likely we should not only have no sockets, but not even these processes, in which the sockets are formed; and the Jaws can perform their motions, and give origin to muscles, without either the Teeth, or Alveolar Processes. In short, there is such a mutual dependence of the Teeth, and Alveolar Processes on each other, that the destruction of the one seems to be always attended with that of the other.

* Vide Plate I. Fig. 1. and 2.

† Vide Plate I. Fig. 2.

8 OF THE ALVEOLAR PROCESSES.

In the head of a young subject which I examined, I found that the two first Incisor Teeth in the Upper-Jaw had not cut the Gum ; nor had they any root or fang, excepting so much as was necessary to fasten them to the Gum, on their upper surface ; and on examining the Jaw, I found there was no Alveolar Process, nor sockets, in that part. What had been the cause of this, I will not pretend to say : whether it was owing to the Teeth forming not in the Jaw, but in the Gum ; or to the wasting of the fangs. The appearance of the Tooth favoured the first supposition ; for it was not like those, whose fangs are decayed in young subjects, in order to the shedding of the Teeth ; and as it did not cut the Gum, it is reasonable to think it never had any fang. That end from which the fang should have grown, was formed into two round and smooth points, having each a small hole leading into the body of the Tooth, which was pretty well formed.

OF THE
ARTICULATION of the LOWER-JAW.

JUST under the beginning of the Zygomatic Process of each Temporal Bone, before the external Meatus Auditorius, an oblong cavity may be observed ; in direction, length, and breadth, in some measure corresponding with the Condyle of the Lower-Jaw *. Before, and adjoining to this cavity, there is an oblong eminence, placed in the same direction, convex upon the top, in the direction of its shorter axis, which runs from behind forwards ; and a little concave in the direction of its longer axis, which runs from within outwards. It is a little broader at its outer extremity ; as the outer corresponding end of the Condyle describes a larger circle in its motion than the inner †. The surface of the cavity, and eminence, is covered with one continued smooth cartilaginous crust, which is somewhat ligamentous, for by putrefaction it peels off, like a membrane, with the common Periosteum. Both the cavity and eminence serve for the mo-

* Vide Plate II. L. and Plate IV. E E.

† Vide Plate II. K. and Plate XIV. F F.

tion of the Condyle of the Lower-Jaw. The surface of the cavity is directed downward; that of the eminence downward and backward, in such a manner that a transverse section of both would represent the Italic letter S*. Though the eminence may, on a first view of it, appear to project considerably below the cavity, yet a line drawn from the bottom of the cavity, to the most depending part of the eminence, is almost horizontal, and therefore nearly parallel with the line made by the grinding surfaces of the Teeth in the Upper-Jaw: and when we consider the Articulation farther, we shall find that these two lines are so nearly parallel, that the Condyle moves almost directly forwards, in passing from the cavity to the eminence; and the parallelism of the motion is also preserved by the shape of an intermediate cartilage.

In this joint there is a moveable cartilage, which, though common to both Condyle and cavity, ought to be considered rather as an appendage of the former than of the latter, being more closely connected with it; so as to accompany it in its motion along the common surface of both the cavity and eminence. This cartilage is nearly of the same dimensions with the Condyle, which it covers; is hollowed on its inferior surface, to receive the Condyle: on its upper surface it is more unequal, being moulded to the cavity and eminence of the ar-

* Vide Plate II. I, K.

articulating surface of the Temporal Bone, though it is considerably less, and is therefore capable of being moved with the Condyle, from one part of that surface to another*. Its texture is ligamento-cartilagineous. This moveable cartilage is connected with both the Condyle of the Jaw, and the articulating surface of the Temporal Bone, by distinct ligaments, arising from its edges all round. That by which it is attached to the Temporal Bone, is the most free and loose; though both ligaments will allow an easy motion, or sliding of the cartilage on the respective surfaces of the Condyle, and Temporal Bone. These attachments of the cartilage are strengthened, and the whole articulation secured, by an external ligament, which is common to both, and which is fixed to the Temporal Bone, and to the neck of the Condyle. On the inner surface of the ligament, which attaches the cartilage to the Temporal Bone, and backwards, in the cavity, is placed what is commonly called the Gland of the Joint; at least, the ligament is there much more vascular than at any other part.

* Vide Plate II. L.

MOTION in the JOINT of the LOWER-JAW.

THE Lower-Jaw, from the manner of its articulation, is susceptible of a great many motions. The whole Jaw may be brought horizontally forwards, by the Condyles sliding from the cavity towards the eminences on each side. This motion is performed chiefly when the Teeth of the Lower-Jaw are brought directly under those of the Upper, in order to bite, or hold any thing very fast between them.

Or, the Condyles only may be brought forwards, while the rest of the Jaw is tilted backwards, as in the case when the Mouth is open; for on that occasion the angle of the Jaw is tilted backwards, and the chin moves downwards, and a little backwards also. In this last motion, the Condyle turns its face a little forwards; and the center of motion lies a little below the Condyle, in the line between it and the angle of the Jaw. By such an advancement of the Condyles forwards, together with the rotation mentioned, the aperture of the Mouth may be considerably enlarged; a circumstance necessary on many obvious occasions.

The

The Condyles may also slide alternately backwards and forwards, from the cavity to the eminence, and *vice versa* ; so that while one Condyle advances, the other moves backwards, turning the body of the Jaw from side to side, and thus grinding, between the Teeth, the morsel separated from the larger mass by the motion first described. In this case, the center of motion lies exactly in the middle between the two Condyles. And it is to be observed, that in these slidings of the Condyles forwards and backwards, the moveable cartilages do not accompany the Condyles in the whole extent of their motion ; but only so far as to adapt their surfaces to the different inequalities of the Temporal Bone : for as these cartilages are hollow on their lower surfaces where they receive the Condyle, and on their opposite upper surfaces are convex where they lie in the cavity ; but forwards, at the root of the eminence, that upper surface is a little hollowed ; if they accompanied the Condyles through the whole extent of their motion, the eminences would be applied to the eminences, the cavities would not be filled up, and the whole articulation would be rendered very insecure.

This account of the motion of the Lower-Jaw, and its cartilages, clearly demonstrates the principal use of these cartilages ; namely, the security of the articulation ; the surfaces of the cartilage accommodating themselves to the different inequalities, in the various and
free:

free motions of this joint. This cartilage is also very serviceable for preventing the parts from being hurt by the friction; a circumstance necessary to be guarded against, where there is so much motion. Accordingly, I find this cartilage in the different tribes of Carnivorous Animals, where there is no eminence and cavity, nor other apparatus for grinding; and where the motion is of the true ginglimus kind only.

In the Lower-Jaw, as in all the joints of the body, when the motion is carried to its greatest extent, in any direction, the muscles and ligaments are strained, and the person made uneasy. The state, therefore, into which every joint most naturally falls, especially when we are asleep, is nearly in the middle, between the extremes of motion; by which means all the muscles and ligaments are equally relaxed. Thence it is, that commonly, and naturally, the Teeth of the two Jaws are not in contact; nor are the Condyles of the Lower-Jaw so far back in the Temporal Cavities as they can go.

OF THE
MUSCLES of the LOWER - JAW.

HAVING described the figure, Articulation, Motion, and use of the Lower-Jaw, it will be necessary, in the next place, to give some account of the Muscles that are the causes of its motion.

There are five pair of Muscles, each of them capable of producing various motions, according to the situation of the Lower-Jaw, whether they act singly, or in conjunction with others; and two or more of them may be so situated, as to be capable of moving the Jaw in the same direction; and every motion is produced by the action of more than one Muscle at a time. Thus, if the Jaw is depressed, and brought to one side, either the Masseter, Temporal, or Pterigoidæus internus of the opposite side will not only raise the Jaw, but bring it to its middle state. It will be necessary in the description of each Muscle, to give its use in the different situations of the Jaw; by which means, after they are all described, their compound actions will be better understood. I shall first describe those which raise the Jaw; then those which give it the lateral motion; and lastly,

lastly, those which depress it; proceeding in each class as they rise in dissection.

The most superficial is the Masseter: it is situated upon the posterior and lower part of the Face, between the cheek-bone, and angle of the Lower-Jaw, directly before the lower part of the Ear. It is a thick, short, complex Muscle, and a little flattened: it appears to have two distinct origins, an anterior outer, and a posterior inner; but that is owing only to its outer edge at its origin being slit, or double; and the fibres of these two edges having a different course, decussating each other a little. The anterior, and outer portion of the Muscle begin to rise from a small part of the lower edge of the Malar Process of the Maxillary Bone, adjoining to the Os Malæ; and continues its origin all along the lower horizontal edge of this last bone, to the angle where its Zygomatic Process turns up, to join that of the Temporal Bone. The external layer of fibres in this portion are tendinous at their beginnings, while the internal are fleshy.

The posterior and inner portion of this Muscle begins to rise partly tendinous, and partly fleshy, from the same lower edge of the Os Malæ; not where the origin of the other portion terminates, but a little farther forwards; and this origin is continued along the lower edge of the Zygomatic Process of the Temporal

poral Bone, as far backwards as the eminence belonging to the articulation of the Lower-Jaw.

From this extent of its origin, the Muscle passes downwards to its insertion into the Lower-Jaw. The anterior external portion is broader at its insertion than at its origin; for it occupies a triangular space of the Lower-Jaw above the angle, and on the outside, of about an inch in size, to about an inch and a half from the angle towards the Chin. In consequence of this extent of insertion, the fibres of this portion divaricate very considerably. They are mostly fleshy at their insertion, a few only being tendinous, particularly those that are inserted backwards. The posterior and inner portion of the Masseter is narrower at its insertion than at its origin; its posterior fibres running forwards, as well as downwards, while its anterior run almost directly downwards. It occupies in its insertion the remaining part of the scabrous surface, above the angle of the Lower-Jaw, which lies between the anterior portion and the two upper processes, viz. the Condyle and Coronoide. As the anterior fibres of this portion rise on the inside of the posterior fibres of the other portion; and as its posterior fibres run forwards as well as downwards, and its anterior run almost directly downwards, while the fibres of the other portion radiate both forwards and backwards; these two portions in some measure decussate, or cross one another.

D

other.

other. The anterior fibres, which run farthest and lowest down, are tendinous at their insertion, while the posterior and shortest are fleshy.

The use of the whole Muscle is to raise the Lower-Jaw; and when it is brought forwards, the posterior and inner portion will assist in bringing it a little back; so that this Muscle becomes a rotator, if the Jaw happens to be turned to the opposite side.

We may observe, that this Muscle is intermixed with a number of tendinous portions, both at its origin and its insertion; which give rise to a greater number of fleshy fibres, and thereby add to the strength of the Muscle.

TEMPORALIS.

IT is situated on the side of the Head, above, and somewhat before the Ear. It is a pretty broad, flat, and radiated Muscle; broad and thin at its origin; narrow and thick at its insertion; and is covered with a pretty strong Fascia, above the Jugum.

This Fascia is fixed to the bones round the whole circumference of the origin of the Muscle. Above, it is fixed to a smooth white line, that is observable upon the Skull, extending from a little ridge on the lateral part of the Os Frontis, continued across the Parietal Bone, and making a turn towards the Mamillary Process. It is fixed below, to the ridge where the Zygomatic Process begins, just above the Meatus Auditorius; then to the upper edge of the Zygomatic Process itself, and anteriorly to the Os Malæ. This adhesion, anteriorly, above, and posteriorly, gives, as it were, the circumference of the origin of the Temporal Muscle.

This Muscle arises from all the bones of the side of the Head, that are within the line, for insertion of the tendinous Fascia, viz. from the lower and lateral part of the Parietal Bone, from all the squamous portion of

the Temporal Bone, from the lower and lateral part of the Os Frontis, from all the Temporal Procefs of the Os Sphenoides, and often from a procefs at the lower part of this furface, (which portion, however, is often common to this Mufcle, and the Pterygoidæus externus) and from the posterior furface of the Os Malæ. Outwardly, it rifes from the inner furface of the Jugum, and from the whole inner furface of the Fascia above described. At this origin, from the Jugum it is not to be diftinguifhed from the Maffeter, being there, in fact, one and the fame Mufcle; and indeed the Maffeter is no more than a continuation of the fame origin, under the edge of the Jugum; and might properly enough be reckoned the fame, both as to its origin and infertion, and in fome meafure in its ufe alfo.

The origin is principally flefhy; and the Mufcle paffes from it, in general, downwards, and a little forwards, converging, and forming a thin middle tendon. After which the Mufcle runs downwards, on the infide of the Jugum, and is inferted into the Coronoid Procefs of the Lower-Jaw, on both fides tendinous and flefhy, but principally tendinous. It reaches farther down upon the infide of the Coronoid Procefs, than upon the outer fide, where the infertion is continued as low as the body of the bone.

The

The posterior and inferior edge of this Muscle passes over the root of the Zygomatic Process of the Temporal Bone, as over a pulley, which confines the action of the Muscle to that of raising the Lower-Jaw, more than if its fibres had passed in a direct course from their origin to their insertion.

The use of the Temporal Muscle, in general, is to raise the Lower-Jaw; and as it passes a little forwards to its insertion, it must bring the Condyle at the same time backwards, and so counteract the Pterygoidæus externus of the opposite side; and if both Muscles act, they counteract both the Pterygoidæi, by bringing back the whole of the Jaw.

PTERY-

PTERYGOIDÆUS INTERNUS.

IT is situated upon the inside of the Lower-Jaw, opposite to the Masseter, which is upon the outside. It is a strong short Muscle, a little flattened, especially at its insertion. It arises tendinous and fleshy from the whole internal surface of the external Ala of the Sphenoid Bone ; from the external surface of the internal Ala, near its bottom ; from that process of the Os Palati that makes part of the Fossa Pterygoidæa ; likewise from the anterior rounded surface of that process, where it is connected to the Os Maxillare superius. From thence the Muscle passes downwards, a little outwards and backwards, and is inserted tendinous and fleshy into the inside of the Lower-Jaw, from the angle, up almost to the groove for the admission of the Maxillary Nerve, where the surface of the bone is remarkably scabrous.

The Use of this Muscle is to raise the Lower-Jaw ; and from its direction, one would suspect that it would bring the Condyle a little forwards ; but this motion is contrary to that of the Lower-Jaw, for it is naturally brought back when raised.

PTERY-

PTERYGOIDÆUS EXTERNUS,

IS situated immediately between the external surface of the external Ala of the Pterygoid Process, and the Condyle of the Lower-Jaw; lying, as it were, horizontally along the basis of the Skull. It is somewhat radiated in some bodies; broad at the origin, and small at the insertion; but the greater part of it forms a round strong fleshy belly; so that the part that makes it of the radiated kind is thin.

The thick and ordinary portion of it arises tendinous and fleshy, from almost the whole external surface of the external Ala of the Pterygoid Process of the Sphenoid Bone, excepting a little bit of the root at the posterior edge; and towards the lower part, it arises a little from the inner surface of that Ala. The thin portion arises from a ridge of the Sphenoid, that is continued from the process towards the Temple, just behind the Foramen Lacerum inferius, which terminates in a little protuberance. This origin is sometimes wanting; and in that case, the Temporal Muscle arises from that protuberance; and very often this origin is common to both. These two origins of this Muscle are sometimes so much separated, as to make it a Biceps.

From these origins the Muscle passes outwards, and a little backwards, converging ; that is, the superior fibres passing outwards and backwards, and a little downwards ; while the inferior, or larger portion of it, passes a little upward.

It is inserted tendinous and fleshy into a depression on the anterior part of the Condyle and Neck of the Lower-Jaw, upon the inside of that ridge, which is continued from the Coronoid Process. Likewise a little portion into the anterior part of the moveable cartilage. A little portion is likewise inserted into the anterior part of the moveable cartilage of the joint.

When this Muscle acts singly it is a rotator ; for it brings the Condyle of the Jaw forwards, and likewise the moveable cartilage, which throws the Chin to the opposite side : but if it acts in conjunction with its fellow of the opposite side, instead of being turned to one side, the whole Jaw is brought forwards, and thus these counteract the Temporal, &c.

These two Muscles generally act alternately ; and when they do so, one acts at the time of depression, the other at the time of elevation ; so that these Muscles act, both when the Lower-Jaw is raised, and when it is depressed : yet they do not assist either in raising or depressing it.

DIGAS-

D I G A S T R I C U S.

IT is situated immediately under, and a little upon the inside of the Lower-Jaw, and outside of the Fauces, extending from the Mastoid Process to the Chin, nearly along the angle made by the Neck and Chin, or Face *. The name of this Muscle expresses its general shape, as it has two fleshy bellies, and of course a middle tendon. Yet some of its anterior belly does not arise from the tendon of the posterior, but from the Fascia, which binds it to the Os Hyoides. — These two fleshy bellies do not run in the same line, but form an angle, just where the tendon runs into the anterior belly; so that this tendon seems rather to belong to the posterior, which is the thickest and longest.

This Muscle arises from the Sulcus made by the inside of the Mastoid Process, and a ridge upon the Temporal Bone, where it is united with the Os Occipitis. The extent of this origin is about an inch: it is fleshy upon its outer part, viz. that from the Mastoid Process, and tendinous on the inside from the ridge. From its

* Vide Plate II. E F.

origin it passes forwards, downwards, and a little inwards, much in the direction of the posterior edge of the Mammillary Process; and forms a round tendon first in its center and upper surface. This tendon passes on in the same direction; and when got near the Os Hyoides, it commonly perforates the anterior end of the Stylo-Hyoidæus Muscle; and from the lower edge of this tendon, some fibres seem to go off, which degenerate into a kind of Fascia, that binds it to the Os Hyoides; and some of it goes across the lower part of the Mylo-Hyoidæus, and joins its fellow on the opposite side; binding the Os Hyoides by a kind of belt. At this part the tendon becomes a little broader, makes a turn upwards, inwards, and forwards, and gives origin to the anterior belly, which passes on in the same direction, to the lower part of the Chin, where it is inserted tendinous and fleshy, into a slight depression on the under, and a little on the posterior part of the Lower-Jaw, almost contiguous to its fellow. Besides the attachment of the middle tendon to the Os Hyoides, there is a ligamentous binding, which serves, in some measure, as a pulley. This is more marked in some subjects than in others; and this depends on the strength of the tendinous expansion, which binds the tendon of the Digastricus to the Os Hyoides.

When we say that these parts are attached to the

Os

Os Hyoides, we do not mean that they can be traced quite into it, like some other tendons in the body; but the Os Hyoides seems to be the most fixt point of attachment. Very often we find two anterior bellies to each Muscle; the uncommon one, which is the smallest, does not pass to the Chin, but joins with a similar portion of the other side, in a middle tendon, which is often fixed to the Os Hyoides. At other times, we find such a portion on one side only; in which case it is commonly fixed to the middle tendon of the Mylo-Hyoidæus.

The use of these Muscles with regard to the Lower-Jaw, is principally to depress it; but according as one acts a little more forcibly than the other, it thereby gives the Jaw a small rotation; and becomes, in that respect, a kind of antagonist to the Pterygoidæus Externus. Besides depressing the Lower-Jaw, when we examine the dead body, they would appear to raise the Larynx. But although they have this effect, a proper attention to what happens in the living body, will probably shew, that their principal action is to depress the Lower-Jaw, and that they are the Muscles which are commonly employed for this purpose. Let a Finger be placed on the upper part of the Sternomastoidæus Muscle, just behind the posterior edge of the Mastoid Process, about its middle, touching that edge a little with the finger; then depress the Lower-

Jaw, and the posterior head of the Digastric will be felt to swell very considerably, and so as to point out the direction of the Muscle. In this there can be no deception; for there is no other Muscle in this part that has the same direction; and those who are of opinion that the Digastric does not depress the Lower-Jaw, will more readily allow this, when they are told, that we find the same head of the Muscle act in deglutition; but not with a force equal to that which it exerts in depressing the Lower-Jaw. Further, if the Sterno-Hyoidei, Sterno-Thyroidei, and Costo-Hyoidei, acting at the same time with the Mylo-Hyoidei, and Genio-Hyoidei, assisted in depressing the Jaw, the Os Hyoides, and Thyroide Cartilage, would probably be depressed, as the bellies of the Sterno-Hyoidei, and of the other lower muscles, are by much the longest; but on the contrary, we find that the Os Hyoides, with the Thyroide Cartilage, is a little raised in the depression of the Jaw, which we may suppose to be done by the anterior belly of the Digastric: and secondly, if these Muscles were to act to bring about this motion of the Jaw, these parts would be brought forwards, nearer to the straight line between the Chin and Sternum, which is not the case in this action; whereas we find it to be the case in deglutition, in which these evidently act. By applying our Fingers upon the Genio-Hyoideus, and Mylo-Hyoideus, near the Os Hyoides, between the two anterior bellies of the Digastric, (not near the Chin, where

where the action of these two bellies may occasion a mistake), we find these Muscles quite flaccid; which is not the case in deglutition, nor in speaking, in which they certainly do act; nor do we find the Muscles under the Os Hyoides at all affected, as they are in the motion of the Larynx.

It has been observed, that when we open the mouth, while we keep the Lower-Jaw fixed, the forepart of the Head or Face is necessarily raised. Authors have been at a good deal of pains to explain this. Some of them considered the Condyles of the Jaw, as the center of motion; but if this were the case, that part of the Head, where it articulates with the Spine, and of consequence the whole body, must be depressed, in proportion as the Upper-Jaw is raised; which is not true in fact. Others have considered the Condyles of the Occiput as the center of motion; and they have conceived the Extensor Muscles of the Head to be the moving powers. The Muscles which move the Head in this case, are pointed out by two circumstances, which attend all muscular motion; in the first place, all actions of our body have Muscles immediately adapted to them; and secondly, when the mind wills any particular action, its power is applied by instinct to those Muscles only, which are naturally adapted to that motion; and further, the mind being accustomed to see the part move which is naturally the most moveable, attends to its motion in the volition, although

though it be in that instance fixed, and the other parts of the body move towards it ; and although the other parts of the body might be brought towards it by other Muscles, and would be so, if the mind intended that they should come towards it, yet these Muscles are not brought into action. Thus the Flexors of the Arm commonly move the hand to the body ; but if the hand be fixed, the body is moved by the same Muscles to the hand. In this case, however, the mind wills the motion of the hand towards the body, and brings the Flexors into action ; whereas if it wished to bring the body towards the hand, the Muscles of the forepart of the body would be put into action, and this would produce the same effect.

To apply this to the Lower-Jaw ; when we attempt to open the Mouth, while the Lower-Jaw is immovable, we fix our attention upon the very same Muscles (whatever they are) which we call into action, when we depress the Lower-Jaw ; and we find that we act with the very same Muscles ; for our mind attends to the depressing of the Jaw, and not the raising of the face ; and under such circumstances the mouth is actually opened. We find then by these means the head is raised ; and the idea that we have of this motion, is the same that we have in the common depression of the Jaw ; and we should not know, except from circumstances, that the Jaw was not really depressed ; and we

we find at this time too, that the Extensors of the head are not in action. On the contrary, when the Jaw is fixed in the same situation, if we have a mind to raise the head, or Upper-Jaw, which of course must open the mouth, we fix our attention to the Muscles that move the head backwards, without having the idea of opening our mouth; and at this time the Extensors of the head act. This plainly shows, that the same Muscles which depress the Jaw, when moveable, must raise the head, when the Jaw is kept fixed.

This is a proof too, that there are no other Muscles employed in depressing the Lower-Jaw, than what will raise the head under the circumstances mentioned. This will further appear from the structure of the parts; wherein four things are to be considered, viz. the articulation of the Jaw; the articulation of the Head with the Neck; the origin, and the insertion of Digastric Muscle.

* Suppose A, the Upper-Jaw, to be fixed, and the Lower-Jaw B, to be moveable on the Condyle C: if the Digrastric contracts, its origin E, and insertion F will approach towards one another; in which case it is evident, that the Lower-Jaw will move downwards and backwards. But if the Lower-Jaw be fixed, as in the case supposed, and the Vertebrae G G G be also fixed,

* Vide Plate II.

the

the Condyle will move upwards and forwards upon the eminence in the joint, the forepart of the head will be pushed upwards and backwards by the Condyle, and the hind part of the head will be drawn down; so that the whole shall make a kind of circular motion upon the upper Vertebrae; and the Digastric Muscle pulling the hind part of the head towards the Lower-Jaw, and at the same time pushing up the Condyles against the fore-part of the head, acquires, by this mechanifm, a very confiderable additional power.

OF

OF THE
STRUCTURE of a TOOTH.

And, First, of the ENAMEL.

A Tooth is composed of two substances, viz. Enamel and Bone. The Enamel, called likewise the vitreous, or cortical part, is found only upon the body of the Tooth, and is there laid all around, on the outside of the bony, or internal substance*. It is by far the hardest part of our body; in-
somuch that the hardest and sharpest saw will scarce make an impression upon it, and we are obliged to use a file in dividing or cutting it. When it is broken it appears fibrous or striated; and all the fibres or striæ are directed from the circumference to the center of the Tooth †.

This, in some measure, both prevents it from breaking in mastication, as the fibres are disposed in arches, and keeps the Tooth from wearing down, as the ends of the fibres are always acting on the food.

* Vide Plate XIV. Fig. 14, 15, and 17.

† Vide Plate XIV. Fig. 21, 22, and 23.

The Enamel is thickest on the grinding surface, and on the cutting edges, or points, of the Teeth; and becomes gradually thinner on the sides, as it approaches the neck, where it terminates insensibly, though not equally low, on all sides of the Teeth*. On the base or grinding surface it is of a pretty equal thickness, and therefore is of the same form with the bony substance which it covers †.

It would seem to be an earth united with a portion of animal substance, as it is not reducible to quick lime by fire, till it has first been dissolved in an acid. When a Tooth is put into a weak acid, the Enamel, to appearance, is not hurt; but on touching it with the fingers, it crumbles down into a white pulp. The Enamel of Teeth, exposed to any degree of heat, does not turn to lime: it contains animal mucilaginous matter; for when exposed to the fire, it becomes very brittle, cracks, grows black, and separates from the inclosed bony part of the Tooth. It is capable, however, of bearing a greater degree of heat than the bony part, without becoming brittle and black ‡. This substance has no marks of being vascu-

* Vide Plate XIV. Fig. 21, 22, and 23.

† Vide Ditto.

‡ From this circumstance we can shew the Enamel better by burning a Tooth, as the bony part becomes black sooner than the Enamel. The method of burning, and shewing them after they are burnt, is as follows.—Let one half of a Tooth be filed away, from one end to the other, then burn it gently in the fire; after this is done, wash the filed surface

lar, and of having a circulation of fluids: the most subtle injections we can make never reach it; it takes no tinge from feeding with madder, even in the youngest animals; and, as was observed above, when soaked in a gentle acid, there appears no *gristly* or *fleshy* part, with which the earthy part had been incorporated *.

We shall speak of the use and formation of the Enamel hereafter, when they will be better understood.

surface with an acid, or scrape it with a knife. By this method you will clean the edge of the Enamel, which will remain white, and the bony part will be found black.

* In all these experiments I never could observe, that the Enamel was in the least tinged, either in the growing or formed Tooth. This looks as if the Enamel were the earth more fully depurated, or strained off from the common juices in such a manner, as not to allow the gross particles of madder to pass. Here it may not be amiss to remark, that the names given to animal substance, such as Gluten, &c. are not in the least expressive of the thing meant; for there is no such thing as glue in an animal, till it has either undergone a putrefactive process, or been changed by heat. And here too I would be understood, that I call earth no part of an animal; nor does it make up any part of an animal substance.

OF THE
BONY PART of a TOOTH.

THE other substance of which a Tooth is composed, is bony ; but much harder than the most compact part of bones in general. This substance makes the interior part of the body, the neck, and the whole of the root of a Tooth. It is a mixture of two substances, viz. calcarious earth and an animal substance, which we might suppose to be organized and vascular. The earth is in very considerable quantity ; it remains of the same shape after calcination, so that it is in some measure kept together by cohesion ; and it is capable of being extracted by steeping in the muriatic, and some other acids. The animal substance, when deprived of the earthy part, by steeping in an acid, is more compact than the same substance in other bones, but still is soft and flexible.

That part of a Tooth which is bony, is nearly of the same form as a complete Tooth ; and thence, when the Enamel is removed, it has the same sort of edge, point, or points, as when the Enamel remained. We cannot by injection prove that the bony part of a Tooth is vascular :

vascular: but from some circumstances it would appear that it is so; for the Fangs of Teeth are liable to swellings, seemingly of the *spina ventosa* kind, like other bones; and they sometimes anchylose with the socket by bony and inflexible continuity, as all other contiguous bones are apt to do. But there may be a deception here, for the swelling may be an original formation, and the anchylosis may be from the pulp that the Tooth is formed upon being united with the socket. The following considerations would seem to shew that the Teeth are not vascular: first, I never saw them injected in any preparation, nor could I ever succeed in any attempt to inject them, either in young or old subjects; and therefore believe that there must have been some fallacy in the cases where they have been said to be injected. Secondly, we are not able to trace any vessels going from the pulp into the substance of the new-formed Tooth; and whatever part of a Tooth is formed, it is always completely formed, which is not the case with other bones. But what is a more convincing proof, is reasoning from the analogy between them and other bones, when the animal has been fed with madder. Take a young animal, viz. a pig, and feed it with madder, for three or four weeks; then kill the animal, and upon examination you will find the following appearance: first, if this animal had some parts of its Teeth formed before the feeding with madder, those parts will be known by their remaining of this natural colour; but

but such parts of the Teeth as were formed while the animal was taking the madder, will be found to be of a red colour. This shews, that it is only those parts that were forming while the animal was taking the madder that are dyed; for what were already formed will not be found in the least tinged. This is different in all other bones; for we know that any part of a bone which is already formed, is capable of being dyed with madder, though not so fast as the part that is forming; therefore as we know that all other bones when formed are vascular, and are thence susceptible of the dye, we may readily suppose that the Teeth are not vascular, because they are not susceptible of it after being once formed. But we shall carry this still farther; if you feed a pig with madder for some time, and then leave it off for a considerable time before you kill the animal, you will find the above appearances still subsisting, with this addition, that all the parts of the Teeth which were formed after leaving off feeding with the madder will be white. Here then in some Teeth we shall have white, then red, and then white again; and so we shall have the red and the white colour alternately through the whole Tooth.

This experiment shews, that the Tooth once tinged, does not lose its colour; now as all other bones that have been once tinged lose their colour in time, when the animal leaves off feeding with madder (though very slowly), and as that dye must be taken into the

consti-

constitution by the absorbents, it would seem that the Teeth are without absorbents, as well as other vessels.

This shews that the growth of the Teeth is very different from that of other bones. Bones begin at a point, and shoot out at their surface; and the part that seems already formed, is not in reality so, for it is forming every day by having new matter thrown into it, till the whole substance is complete; and even then it is constantly changing its matter.

Another circumstance in which Teeth seem different from bone, and a strong circumstance in support of their having no circulation in them, is that they never change by age, and seem never to undergo any alteration, when completely formed, but by abrasion; they do not grow softer, like the other bones, as we find in some cases, where the whole earthy matter of the bones has been taken into the constitution.

From these experiments it would appear, that the Teeth are to be considered as extraneous bodies, with respect to a circulation through their substance; but they have most certainly a living principle, by which means they make part of the body, and are capable of uniting with any part of a living body; as will be explained hereafter: and it is to be observed, that affections of the whole body have less influence upon the Teeth
than

than any other part of the body. Thus in children affected with the rickets, the Teeth grow equally well as in health, though all the other bones are much affected; and hence their Teeth being of a larger size in proportion to the other parts, their mouths are protuberant.

a y joined, nerves, united by a
pulp or cellular substance. The vessels are branches
of the superior and inferior Maxillaries; and the
nerves must come from the second and third branches

CAVITY of the T E E T H.

EVERY Tooth has an internal Cavity, which extends nearly the whole length of its bony part *. It opens, or begins at the point of the fang, where it is small; but in its passage becomes larger, and ends in the body of the Tooth †. This end is exactly of the shape of the body of the Tooth to which it belongs. In general it may be said, that the whole of the Cavity is nearly of the shape of the Tooth itself, larger in the body of the Tooth, and thence gradually smaller to the extremity of the fang; simple, where the Tooth has but one root ‡; and in the same manner compounded, when the Tooth has two or more fangs §.

This Cavity is not cellular, but smooth in its surface: it contains no marrow, but appears to be filled with

* Vide Plate XIV. Fig. 1, 2, 3, &c.

† Vide Plate XIV. Fig. 1, 2, 3, &c.

‡ Vide Plate XIV. Fig. 3, 4, 5, and 6.

§ Vide Plate XIV. Fig. 1, 2.

42 OF THE CAVITY OF THE TEETH.

blood-vessels *, and, I suppose, nerves, united by a pulpy or cellular substance. The vessels are branches of the superior and inferior Maxillaries; and the nerves must come from the second and third branches of the fifth pair.

By injections we can trace the blood-vessels distinctly through the whole Cavity of the Tooth; but I could never trace the Nerves distinctly even to the beginning of the Cavity.

* Vide Plate XII. Fig. 7, 8.

OF THE
PERIOSTEUM of the TEETH.

THE Teeth, as we observed, are covered by an Enamel only at their bodies ; but at their fangs they have a Periofteum, which, though very thin, is vascular, and appears to be common to the Tooth which it incloses, and the socket, which it lines as an investing internal membrane, It covers the Tooth a little beyond the bony socket, and is there attached to the Gum.

OF THE

SITUATION of the TEETH.

THE general shape and situation of the Teeth are obvious. The opposition of those of the two Jaws, and the circle which each row describes, need not be particularly explained, as they may be very well seen in the living body, and may be supposed to be already understood, from what was said of the Alveolar Processes.

We may just observe, with regard to the situation of the two rows, that when they are in the most natural state of contact, the Teeth of the Upper-Jaw project a little beyond the lower Teeth, even at the sides of the Jaws ; but still more remarkably at the fore part, where in most people the upper Teeth lie before those of the Lower-Jaw * : and at the lateral part of each row, the line, or surface of contact, is hollow from behind forwards, in the Lower-Jaw ; and in the same proportion it is convex in the Upper-Jaw †.

* Vide Plate III. Fig. 1, 2.

† Vide Plate III. Fig. 1, 2.

The edge of each row is single at the fore part of the Jaws; but as the Teeth grow thicker backwards, it there splits into an internal and external edge. The canine Tooth, which we shall call *Cuspidatus*, is the point from which the two edges go off; so that the first grinder, or what we shall call the first *Bicuspis*, is the first Tooth that has a double edge *.

* Vide Plate IV. Fig. 1, 2.

OF THE
NUMBER of TEETH.

THEIR Number in the whole, at full maturity, is from twenty-eight to thirty-two: I once saw twenty-seven only, never more than thirty-two. Fourteen of them are placed in each Jaw, when the whole number is no more than twenty-eight; and sixteen, when there are thirty-two. If the whole be twenty-nine or thirty-one in number, the Upper-Jaw sometimes, and sometimes the Lower, has one more than the other; and when the Number is thirty, I find them sometimes divided equally between the two Jaws; and in other subjects sixteen of them are in one Jaw, and fourteen in the other. In speaking of the Number of Teeth, I am supposing that none of them have been pulled out, or otherwise lost; but that there are from eight to twelve of those large posterior Teeth, which I call Grinders, and that they are so close planted as to make a continuity in the circle: and in this case, when the number is less than thirty-two, the deficiency is in the last grinder.

The Teeth differ very much in figure from one another; but those on the right side in each Jaw resemble

exactly

exactly those on the left, so as to be in pairs; and the pairs belonging to the Upper-Jaw nearly resemble the corresponding Teeth of the Lower-Jaw in situation, figure, and use*.

Each Tooth is divided into two parts, viz, first, the body, or that part of it which is the thickest, and stands bare beyond the Alveoli and Gums; secondly, the fang, or root, which is lodged within the Gum and Alveolar Process: and the boundary between these two parts, which is grasped by the edge of the Gum, is called the Neck of a Tooth. The bodies of the different Teeth differ very much in shape and size, and so do their roots. The difference must be considered hereafter.

The Teeth of each Jaw are commonly divided into three classes, viz. *Incisors*, *Canine*, and *Grinders*; but from considering some circumstances of their form, growth and use, I chuse to divide them into the four following classes, viz. *Incisores*, commonly called Fore Teeth; *Cuspidati*, vulgarly called *Canine*; *Bicuspides*, or the two first Grinders; and *Molares*, or the three last Teeth. The number of each class, in each Jaw, for the most part, is four *Incisores*, two *Cuspidati*, four *Bicuspides*, and four, five, or six *Molares*.

* Vide Plate III. IV. V.

There is a regular gradation, both in growth and form through these classes, from the *Incisores* to the *Molares*, in which respect the *Cuspidati* are of a middle nature, between the *Incisores* and *Bicuspides*, as the last are between the *Cuspidati* and *Molares*; and thence the *Incisores* and *Molares* are the most unlike in every circumstance * †.

* Vide Plate III. and V.

† It is here to be understood, that the Teeth from which we take our description, are such as are just completely formed, and therefore not in the least worn down by mastication. Our description of each class is taken from the Lower-Jaw; and the difference between them, and their corresponding classes in the Upper immediately follows that description.

OF THE
I N C I S O R E S.

THE *Incisores* are situated in the anterior part of the Jaw; the others more backwards on each side, in the order in which we have named them. The bodies of the *Incisores* are broad, having two flat surfaces, one anterior, the other posterior. These surfaces meet in a sharp cutting edge. The anterior surface is convex in every direction, and placed almost perpendicularly; and the posterior is concave and sloping, so that the cutting edge is almost directly over the anterior surface *.

These surfaces are broadest and the Tooth is thinnest at the cutting edge, or end of the Tooth, and thence they become gradually narrower and the Tooth thicker towards the neck, where the surfaces are continued to the narrowest side, or edge of the fang. The body of an *Incisor*, in a side-view, grows gradually thicker, or broader, from the edge or end of the Tooth to its neck; and these coincide with the flat, or broad side of the fang; so that when we look on the fore part, or on the

* Vide Plate XIV. and Plate V. row 3, 4.

back part of an *Incisor*, we observe it grows constantly narrower from its cutting edge to the extremity of its fang. But in a side-view it is thickest or broadest at its neck, and thence becomes gradually more narrow, both to its cutting edge, and to the point of its fang *.

The Enamel is continued farther down, and is thicker on the anterior and back part of the *Incisores* than on their sides, and is even a little thicker on the fore part than upon the back part of the Tooth. If we view them laterally, either when intire, or when cut down through the middle, but especially in the latter case, it would seem as if the fang was driven like a wedge into, and had split the body or Enamel of the Tooth †. They stand almost perpendicularly, their bodies being turned a little forwards. Their fangs are much shorter than those of the *Cuspidati*, but pretty much of the same length with all the other Teeth of this Jaw ‡.

In the Upper-Jaw they are broader and thicker, especially the two first: their length is nearly the same with those of the Lower-Jaw. They stand a little obliquely, with their bodies turned much more forwards (the first especially) and they generally fall over those of the Under-Jaw.

* Vide Plate V.

† Vide Plate XIV. Fig. 17.

‡ Vide Plate III. Fig. 2.

The two first *Incisores* cover the two first, and half of the second of the Lower-Jaw, so that the second *Incisor* in the Upper-Jaw covers more than half of the second, and more than the half of the *Cuspidatus* of the Under-Jaw*.

The edges of the *Incisores* by use and friction, in some people, become blunt and thicker; and in others they sharpen one another, and become thinner.

* Vide Plate III. Fig. 1.

OF THE C U S P I D A T U S.

THE *Cuspidatus* is the next after the *Incisores* in each Jaw; so that there are four of them in all. They are in general thicker than the *Incisores*, and considerably the longest of all the Teeth *.

The shape of the body of the *Cuspidatus* may be very well conceived, by supposing an *Incisor*, with its corners rubbed off, so as to end in a narrow point, instead of a thin edge †; and the fang differs from that of an *Incisor*, only in being much larger ‡.

The outside of the body of a *Cuspidatus* projects most at the side next the *Incisores*, being there more angular than any where else.

* Vide Plate VI. Fig. 1. Plate V. Row 1, 3d Fig. *bb*.

† Vide Plate IV. Fig. 1, at *bb*.

‡ Vide Plate VI. Fig. 1.

The Enamel covers more of the lateral parts of these Teeth than of the *Incisores* ; they stand perpendicularly, or nearly so, projecting farther out in the circle than the others, so that the two *Cuspidati* and the four *Incisores* often stand almost in a straight line, especially in the Lower-Jaw.

This takes place only in adults, and in them only when the second Teeth are rather too large for the arch of the Jaw ; for we never find this when the Teeth are at any distance from one another, or in young subjects. Their points commonly project beyond the horizontal line formed by the row of Teeth, and their fangs run deeper into the Jaws, and are oftener a little bent.

In the Upper-Jaw they are rather longer, and do not project much beyond the circle of the adjacent Teeth ; and in this Jaw they are not placed vertically, their bodies being turned a little forwards and outwards.

When the Jaws are closed, the *Cuspidatus* of the Upper-Jaw falls between, and projects a little over the *Cuspidatus* and first *Bicuspis* of the Lower-Jaw. When they are a little worn down by use, they commonly first take an edge somewhat like a worn *Incisor*, and afterwards become rounder.

The

The use of the *Cuspidati* would seem to be, to lay hold of substances, perhaps even living animals; they are not formed for dividing as the *Incisores* are; nor are they fit for grinding. We may trace in these Teeth a similarity in shape, situation, and use, from the most imperfectly carnivorous animal, which we believe to be the human species, to the most perfectly carnivorous, viz. the lion.

This takes place only in adults, and when the second Teeth are rather too large for the arch of the jaw; for we never find this when the Teeth are at any distance from one another, or in young Subjects. Their points commonly project beyond the horizontal line formed by the row of Teeth, and their fangs run deeper into the Jaw, and are often a little bent.

In the Upper-Jaw they are rather longer, and do not project much beyond the circle of the adjacent Teeth; and in this Jaw they are not placed vertically, their bodies being turned a little forwards and outwards.

When the Jaws are closed, the Canine of the Upper-Jaw falls between, and projects a little over the Canine and first Molar of the Lower-Jaw. When they are a little worn down by use, they commonly still take an somewhat like a worn fang, and afterwards become rounder.

The

OF THE BICUSPIDES.

Immediately behind the *Cuspidati*, in each Jaw, stand two Teeth, commonly called the first and second Grinders, but which, for reasons hinted at above, I shall suppose to constitute a particular class, and call them *Bicuspides*.

These (viz. the fourth and fifth Tooth from the symphysis of the Jaw) resemble each other so nearly, that a description of the first will serve for both. The first indeed is frequently the smallest, and has rather the longest fang, having somewhat more of the shape of the *Cuspidatus* than the second.

The body of this Tooth is flattened laterally, answering to the flat side of the fang. It terminates in two points, viz. one external and one internal. The external is the longest and thickest; so that on looking into the mouth from without, this point only can be seen, and the Tooth has very much the appearance of a *Cuspidatus*; especially the first of these Teeth. The internal point

is the least, and indeed sometimes so very small, that the Tooth has the greatest resemblance to a *Cuspidatus* in any view *. At the union of the points the Tooth is thickest, and thence it loses in thickness, from side to side, to the extremity of the fang; so that the fang continues pretty broad to the point, and is often forked there. All the Teeth hitherto described often have their points bent, and more particularly the *Cuspidati*.

The Enamel passes somewhat farther down externally and upon the inside, than laterally; but this difference is not so considerable as in the *Incisores*, and *Cuspidati*; in some indeed it terminates equally all round the Tooth. They stand almost perpendicularly, but seem to be a little turned inwards, especially the last of them.

In the Upper-Jaw they are rather thicker than in the Lower, and are turned a very little forwards and outwards. The first in the Upper-Jaw falls between the two in the Lower. The second falls between the second and the first Grinder: and both project over those of the Lower-Jaw, but less than the *Incisores* and *Cuspidati*.

The *Bicuspides*, and especially the second of them, in both Jaws, are oftener naturally wanting than any of

* Vide Plate IV. Fig. 1, 2, &c.

the Teeth, except the *Dentes Sapiientiæ*; thence we might conjecture that they are less useful; and this conjecture appears less improbable, when we consider, that in their use they are of a middle nature between Cutters and Grinders; and that in most animals, so far as I have observed, there is a vacant space between the Cutters and Grinders. I have also seen a Jaw in which the first *Bicuspis* was of the same shape and size as a Grinder, and projected, for want of room, between the *Cuspidatus* and second *Bicuspis*. These and the Grinders alter very little in shape on their grinding surfaces by use; their points only wear down, and become obtuse.

OF THE
GRINDERS.

IN describing the Grinders we shall first consider the first and second conjunctly, because they are nearly the same in every particular ; and then give an account of the third or last Grinder, which differs from them in some circumstances.

The two first Grinders differ from the Bicuspidæ, principally in being much larger, and in having more points upon their body, and more fangs *.

The body forms almost a square, with rounded angles. The grinding surface has commonly five points, or protuberances, two of which are on the inner, and three on the outer part of the Tooth ; and generally some smaller points at the roots of these larger protuberances. These protuberances make an irregular cavity in the middle of the Tooth. The three outer points do not stand so near the outer edge of the Tooth, as the inner do on the inside ; so that the body of the Tooth

* Vide Plate IV. Fig. 1, 2, *d d*.

swells out more from the points, or is more convex, on the outside. The body towards its neck becomes but very little smaller, and there divides into two flat fangs, one forwards, the other backwards, with their edges turned outwards and inwards, and their sides consequently forwards and backwards: the fangs are but very little narrower at their ends, which are pretty broad, and often bifurcated. There are two cavities in each fang, one towards each edge, leading to the general cavity in the body of the Tooth. These two cavities are formed by the meeting of the sides of the fang in the middle, thereby dividing the broad and flat cavity into two *; and all along the outside of these (and all the other flat fangs) there is a corresponding longitudinal groove. These fangs at their middle, are generally bent a little backwards †.

The Enamel covers the bodies of these Teeth pretty equally all round.

The first Grinder is somewhat larger and stronger than the second; it is turned a little more inwards than the adjacent *Bicuspid*, but not so much as the second Grinder. Both of them have generally shorter fangs than the *Bicuspid*.

* Vide Plate XIV. Fig. 7, where four dark spots are observed.

† Vide Plate VI. Fig. 1.

There is a greater difference between these Grinders in the Upper and Lower-Jaw, than any of the other Teeth. In the Upper-Jaw they are rather rhomboidal, than square in their body, with one sharp angle turned forwards and outwards, the other backwards and inwards; besides they have three fangs, which diverge, and terminate each in a point; these are almost round, and have but one cavity. Two of them are placed near each other perpendicularly, over the outside of the Tooth; and the other, which generally is the largest, stands at a greater distance on the inside of the Tooth, slanting inwards. In this Jaw these two Grinders are inclined outwards, and a little forwards; they project a little over the corresponding Teeth of the Lower-Jaw, and they are placed further back in the mouth, so that each is partly opposed to two of the Lower-Jaw. The second in the Upper-Jaw is smaller than the others, and the first and second are placed directly under the Maxillary Sinus. I once saw the second Grinder naturally wanting on one side of the Lower-Jaw.

The third Grinder is commonly called *Dens Sapientiæ*; it is a little shorter and smaller than the others, and inclined a little more inwards and forwards. Its body is nearly of the same figure, but rather rounder, and its fangs are generally not so regular and distinct, for they often appear squeezed together; and sometimes there is only one fang, which makes the Tooth conical: it is much

much smaller than the rest of the Grinders. In the Upper-Jaw this Tooth has more variety than in the Lower, and is even smaller than the corresponding Tooth of the Lower, and thence stands directly opposed to it; but for this circumstance the Grinders would reach farther back in the Upper-Jaw than in the Lower, which is not commonly the case.

In the Upper-Jaw this third Grinder is turned but a very little outwards; is frequently inclined somewhat backwards; and it projects over that of the Under-Jaw. It oftener becomes loose than any of the other Teeth.

They are placed under the posterior part of the Maxillary Sinus, and there the parts which compose the Sinus are thicker than in the middle. The variations as to the natural number of the Teeth, depend commonly upon these *Dentes Sapientiæ*.

Thus from the *Incisores* to the first Grinder, the Teeth become gradually thicker at the extremity of their bodies, and smaller from the first Grinder to the *Dens Sapientiæ*. From the *Cuspidatus* to the *Dens Sapientiæ* the fangs become much shorter; the *Incisores* are nearly of the same length with the *Bicuspides*. From the first *Incisor* to the last Grinder, the Teeth stand less out from the sockets and Gums.

The bodies of the Teeth in the Lower-Jaw are turned a little outwards at the anterior part of the Jaw, and thence, to the third Grinder, they are inclined gradually more inwards. The Teeth in the Upper-Jaw project over those of the Under, especially at the fore-part, which is owing to the greater obliquity of the Teeth in the Upper-Jaw; for the circle of the sockets is nearly the same in both Jaws. This oblique situation, however, becomes gradually less, from the *Incisores* backwards, to the last Grinder, which makes them gradually project less in the same proportion.

The Teeth in the Upper-Jaw are placed farther back in the circle than the corresponding Teeth of the Lower; this is owing to the two first *Incisores* above being broader than the corresponding *Incisores* below. All the Teeth have only one fang, except the Grinders, each of which has two in the Lower-Jaw, and three in the Upper*.

The fangs bear a proportion to the bodies of the Teeth; and the reason is evident, for otherwise they would have been easily broken, or pushed out of their sockets. The force commonly applied to them is oblique, not perpendicular; and they are not so firmly fixed in

* Those Anatomists who allow the Teeth to have more fangs, have been led into a mistake, I suppose, by often observing two canals in one fang; and thence concluded, that such a fang was originally two, and that these were now grown together.

the Upper-Jaw, that is, the Alveolar Process in that is not so strong as in the Under-Jaw: it is perhaps on this account, that the Grinders in that Jaw have three fangs.

This particular structure in the Alveolar Process of the Upper-Jaw, is perhaps to give more room for the *Antrum Highmorianum*; on this supposition the fangs must be made accordingly, *i. e.* so that they shall not be pushed into that cavity; now, by their diverging, they inclose as it were the bottom of the *Antrum*, and do not push against its middle, which is the weakest part; and the points of three diverging fangs will make a greater resistance (or not be so easily pushed in) than if they were placed parallel. If there had been only two, as in the Lower-Jaw, they must have been placed opposite to the thinnest part of the *Antrum*; and three points placed in any direction but a diverging one, would have had here much the same effect as two; and as the force applied is endeavouring to depress the Tooth, and push it inwards, the innermost fang diverges most, and is supported by the inner wall of the *Antrum*. That all this weakness in the Upper-Jaw is for the increase of the *Antrum* is probable, because all the Teeth in the Upper-Jaw are a good deal similar to those in the Lower, excepting those that are opposite to the Maxillary Sinus; and here they differ principally in the fangs, without any other apparent reason; and
what

what confirms this, is, that the *Dentes Sapientiæ* in both Jaws are more alike than the other Grinders; for this reason, as I apprehend, because the *Dens Sapientiæ* in the Upper-Jaw, does not interfere so much with the Maxillary Sinus.

What makes it still more probable that the two first superior Grinders have three fangs on account of the Maxillary Sinus, is, that the two Grinders on each side of the Upper-Jaw, in the child, have three fangs, and we find them underneath the *Antrum*; but those that succeed them have only one fang, as in the Lower-Jaw; but by that time the *Antrum* has passed further back, or rather the arch of the Jaw has projected, or shot forwards, as it were, from under the *Antra*, so that the Alveolar Processes that were under the *Antrum* at one age, are got before it in another.

That the edge of every fang is turned towards the circumference of the Jaw, in order to counteract the acting power, we shall see when we consider the Motion of the Jaw, and the Use of the Teeth.

OF THE
ARTICULATION of the TEETH.

THE fangs of the Teeth are fixed in the Gum and Alveolar Processes, by that species of Articulation called Gomphosis, which, in some measure, resembles a nail driven into a piece of wood *.

They are not, however, firmly united with the Processes, for every Tooth has some degree of motion; and in heads which have been boiled or macerated in water, so as to destroy the Periosteum and adhesion of the Teeth, we find the Teeth so loosely connected with their sockets, that all of them are ready to drop out, except the Grinders, which remain as it were hooked from the number and shape of their fangs.

* Vide Plate I. for the sockets; and Plate VI. for the Teeth themselves in their sockets.

T H E G U M S.

THE Alveolar Processes are covered by a red vascular substance, called the Gums, which has as many perforations as there are Teeth; and the neck of a Tooth is covered by, and fixed to this Gum. Thence there are fleshy partitions between the Teeth, passing between the external and internal Gum, and, as it were, uniting them; these partitions are higher than the other parts of the Gum, and thence form an arch between every two adjacent Teeth. The thickness of that part of the Gum which projects beyond the sockets is considerable; so that when the Gum is corroded by disease, by boiling, or otherwise, the Teeth appear longer, or less sunk into the Jaw. The Gum adheres very firmly in a healthful state both to the Alveolar Process and to the Teeth, but its extreme border is naturally loose all around the Teeth. The Gum, in substance, has something of a cartilaginous hardness and elasticity, and is very vascular, but seems not to have any great degree of sensibility; for though we often wound it in eating, and in picking our Teeth, yet we do not feel much pain upon these occasions; and both in infants and old people,

8

where

where there are no Teeth, the Gums bear a very considerable preffure, without pain.

The advantage arising from this degree of insensibility in the Gums is obvious, for till the child cuts its Teeth, the Gums are to do the business of Teeth, and are therefore formed for this purpose, having a hard ridge running through their whole length. Old people, who have lost their Teeth, have not this ridge. When in a sound state, the Gums are not easily irritated by being wounded, and therefore are not so liable to inflammation as other parts, and soon heal.

The Teeth being united to the Jaw by the Periosteum and Gum, have some degree of an yielding motion in the living body. This circumstance renders them more secure; it breaks the jar of bony contact, and prevents fractures both of the sockets and of the Teeth themselves.

OF THE

ACTION of the TEETH, arising from the
Motion of the Lower-Jaw.

THE Lower-Jaw may be said to be the only one that has any motion in mastication; for the Upper-Jaw can only move with the other parts of the head. That the Upper-Jaw and head should be raised in the common act of opening the mouth, or chewing, would seem, at first sight, improbable; and from an attentive view of the mechanism of the joints and muscles of those parts, from experiment and observation, we find that they do not sensibly move. We shall only mention one experiment in proof of this, which seems conclusive: let a man place himself near some fixed point, and look over it, to another distant and immoveable object, when he is eating. If his head should rise in the least degree, he would see more of the distant object over the nearest fixed point, which in fact he does not. The nearer the fixed point is, and the more distant the object, the experiment will be more accurate and convincing. The result of the experiment will be the same, if the nearest point has the same motion with the head; as, when he looks from under the edge of a hat, or any thing else put upon

upon his head, at some distant fixed object. We may conclude then that the motion is entirely in the Lower-Jaw: and, as we have already described both the articulation and the motion of the bone, we shall now explain the action of mastication, and, at the same time, consider the use of each class of Teeth.

With regard to the action of the Teeth of both Jaws, in mastication, we may observe, once for all, that their action and re-action must be always equal, and that the Teeth of the Upper and Lower-Jaws are complete, and equal antagonists both in cutting and grinding.

When the Lower-Jaw is depressed, the Condyles slide forwards on the eminences; and they return back again into the cavities, when the Jaw is completely raised.

This simple action produces a grinding motion of the Lower-Jaw, backwards on the Upper, and is used when we divide any thing with our fore Teeth, or *Incisores*. For this purpose, the *Incisores* are well formed; as they are higher than the others, their edges must come in contact sooner; and as the Upper project over the Under, we find in dividing any substance with them, that we first bring them opposite to one another, and as they pass through the part to be divided, the Lower-Jaw is brought back, while the Incisors of that Jaw slide up behind those of the Upper-Jaw, and of course pass

pass by one another. In this way they complete the division, like a pair of scissars ; and at the same time they sharpen one another. There are exceptions to this ; for these Teeth in some people meet equally, viz. in those people whose Fore-Teeth do not project further from the Gum, or socket, than the back Teeth ; and such Teeth are not so fit for dividing ; and in some people the Teeth of the Lower-Jaw are so placed, as to come before those of the Upper-Jaw ; this situation is as favourable for cutting as when the over-lapping of the Teeth is the reverse, except for this circumstance, that the Lower-Jaw must be longer, and therefore its action weaker.

The other motion of the Lower-Jaw, viz. when the lateral Teeth are used, is somewhat different from the former. In opening the mouth, one Condyle slides a little forwards, and the other slides a little further back into its cavity ; this throws the Jaw a little to that side, just enough to bring the lower Teeth directly under their corresponding Teeth in the Upper-Jaw : this is done, either in dividing, or holding of substances ; and these are the Teeth that are generally used in the last mentioned action. When the true grinding motion is to be performed, a greater degree of this last motion takes place ; that is, the Condyle of the opposite side is brought farther forwards, and the Condyle of the same side is drawn farther back into the cavity of the Temporal Bone, and the Jaw is a little depressed.

ed. This is only preparatory for the effect to be produced; for the moving back of the first mentioned Condyle into the socket, is what produces the effect in mastication.

The lateral Teeth in both Jaws are adapted to this oblique motion; in the Lower they are turned a little inwards, that they may act more in the direction of their axis; and here the Alveolar Process is strongest upon the outside, being there supported by the ridge at the root of the Coronoid Process. In the Upper-Jaw the obliquity of the Teeth is the reverse, that is, they are turned outwards, for the same reason; and the longest fang of the Grinders is upon the inside, where the socket is strengthened by the bony partition between the *antrum* and nose. Hence it is, that the Teeth of the Lower-Jaw have their outer edges worn down first; and, *vice versa*, in the Upper-Jaw.

GENE-

GENERAL COMPARISONS

BETWEEN THE

MOTION of the JAW in young and in old People.

IN children who have not yet Teeth, there does not seem to be a sliding motion in the Lower-Jaw. The articular eminence of the Temporal Bone is not yet formed, and the cavity is not larger than the Condyle ; therefore the center of motion in such, must be in the Condyle. In old people, who have lost their Teeth, the centre of motion appears to be in the Condyles, and the motion of their Jaw to be only depression and elevation. They never depress the Jaw sufficiently to bring the Condyle forwards on the eminence, because in them the mouth is sufficiently opened when the Jaw is in its natural position.

Hence it is that in old people, the gums of the two Jaws do not meet in the fore-part of the mouth *, and they cannot bite at that part so well, as at the side of the Jaw ; and, instead of the grinding motion, which

* Vide Plate VII. where the Symphysis of the Lower-Jaw, when the mouth is shut, projects considerably farther forwards than that of the Upper.

would

would be useless, where there are no Grinders; they bruise their food rather by a simple motion of the Jaw upwards and downwards.

It is from the want of Teeth in both those ages, that the face is shorter in proportion to its breadth. In an old person, after the Teeth are gone, the face is shorter, while the mouth is shut, by almost the whole lengths of the Teeth in both Jaws; that is, about an inch and an half.

From the want of Teeth too, at both those ages, the cavity of the mouth is then smaller; and the tongue seems too large and unmanageable, more especially in old people. In these last we observed also, that the chin projects forwards, in proportion as the mouth is shut; because the basis of the Lower-Jaw (which is all that now remains) describes a wider circle than the Alveolar Process in younger people. The Jaws do not project so much forwards in a child, as in an adult; hence the face is flatter, especially at the lower part. In proportion as the last Grinders are produced, the sides of the curve formed by the Jaws become longer, and push forward the fore-part, none of the additional part passing backwards. The fore-part also continues nearly of the same size, so that the whole Jaw is longer in proportion to its breadth, and projects farther forwards.

FORMATION of the ALVEOLAR PROCESS.

HAVING considered the Alveolar Processes in their adult, or perfect state, we shall next examine and trace them from their beginning.

We observe the beginning of the Alveolar Process at a very early period. In a foetus of three or four months it is only a longitudinal groove, deeper and narrower forwards, and becoming gradually more shallow and wider backwards: instead of bony partitions, dividing that groove into a number of sockets, there are only slight ridges across the bottom and sides, with intermediate depressions, which mark the future *Alveoli* *.

In the Lower-Jaw the vessels and nerves run along the bottom of this Alveolar cavity, in a slight groove, which afterwards becomes a complete and distinct bony canal.

* Vide Plate VIII. Fig. 1, 2.

The Alveolar Process grows with the Teeth, and for some time keeps the start of them. The ridges which are to make the partitions shoot from the sides across the canal, at the mouth of the cell, forming hollow arches: this change happens first at the anterior parts of the Jaws*. As each cell becomes deeper, its mouth also grows narrower, and at length is almost, but not quite, closed over the contained Tooth.

The disposition for contracting the mouth of the cell, is chiefly in the outer plate of the bone, which occasions the contracted orifices of the cells to be nearer the inner edge of the Jaw. The reason, perhaps, why the bone shoots over, and almost covers the Tooth, is that the Gum may be firmly supported before the Teeth have come through.

The *Alveoli* which belong to the adult Grinders, are formed in another manner; in the Lower-Jaw they would seem to be the remains of the root of the Coronoid Process†; for the cells are formed for those Teeth in the root of that Process; and in proportion as the body of the bone, and the cells already formed, push forwards from under that Process, the succeeding cells and their Teeth are formed, and pushed forward in the same manner.

* Vide Plate VIII. Fig. 1, 2, 3, 4, 5, and 6.

† Vide Plate VIII. Fig. 7, which is most remarkable in those of the Grinders; as these Alveoli are not opened for the exit of the Teeth.

‡ Vide Plate X. Fig 1.

In the Upper-Jaw there are cells formed in the tubercles for the young Grinders, which at first are very shallow, and become deeper and deeper as the Teeth grow; and they grow somewhat faster, so as almost to inclose the whole Tooth before it is ready to push its way through that inclosure and Gum *. There is a succession of these, till the whole three Grinders are formed.

* Vide Plate I. Fig. 10.

OF THE
FORMATION of the TEETH in the FOETUS.

THE depression, or first rudiments of the *Alveoli* observable in a Foetus of three or four months, is filled with four or five little pulpy substances, which are not very distinct at this age. About the fifth month both the processes themselves and the pulpy substances become more distinct; the anterior of which are the most complete. About this age too the ossifications begin on the edge of the first *Incisores*. The *Cuspidati* are not in the same circular line with the rest, but somewhat on the outside, making a projection there at this age, there not being sufficient room for them.

In the sixth, or seventh month, the edges, or tips, of all these five substances are begun to ossify, and the first of them is a little advanced*; and besides these, the pulp of the sixth Tooth has begun to be formed; it is situated in the tubercle of the Upper-

* Vide Plate X. Fig. 4, 5, where these ossifications are represented.

Jaw, and under and on the inside of the Coronoid Process in the Lower-Jaw: so that at this age, in both Jaws, there are in all twenty Teeth begun to ossify, and the *stamina* of twenty-four. They may be divided into the *Incisores*, *Cuspidati*, and *Molares*; for at this age there are no *Bicuspides*, the two last teeth in each side of both Jaws having all the characteristics, and answering all the purposes of the true *Molares* in the adult, though when these first *Molares* fall out, their places are taken by the *Bicuspides*.

The Teeth gradually advance in their ossification, and about the seventh, eighth, or ninth month after birth, the *Incisores* begin to cut or pass through the Gums; first, generally, in the Lower-Jaw. Before this time the ossifications in the third Grinder, or that which makes the first in the adult, are begun*.

The *Cuspidatus* and *Molares* of the Fœtus are not formed so fast as the *Incisores*; they generally all appear nearly about the same time, viz. about the twentieth, or twenty-fourth month; however, the first Grinder is often more advanced within the socket than the *Cuspidatus*, and most commonly appears before it.

* Vide Plate X. Fig. 6, where the first Incisors had cut the Gum, and where the third Grinder in the child, or first in the adult, was begun to ossify.

These

These twenty are the only Teeth that are of use to the child from the seventh, eighth, or ninth month, till the twelfth or fourteenth year. These are called the Temporary, or Milk Teeth, because they are all shed between the years of seven and fourteen, and are supplied by others.

OF THE

CAUSE of PAIN in DENTITION.

THESE twenty Teeth, in cutting the Gum, give pain, and produce many other symptoms which often prove fatal to children in Dentition. It has been generally supposed that these symptoms arise from the Tooth's pressing upon the inside of the Gum, and working its way mechanically; but the following observations seem to be nearer the truth.

The Teeth, when they begin to press against the Gum, irritate it, and commonly give pain. The Gums are then affected with heat, swelling, redness, and the other symptoms of inflammation. The Gum is not cut through by simple or mechanical pressure, but the irritation and consequent inflammation produces a thinning, or wasting of the Gum at this part: for it often happens that when an extraneous, or a dead substance, is contained in the body, that it produces a destruction of the part between it, and that part of the skin which is nearest it, and seldom of the other parts, excepting those between it and the surface of a cavity opening externally, and that by no means so frequently;

quently. And in those cases there is an absorption of the solids, or of the part destroyed, not a melting down, or solution of them into Pus. The Teeth are to be looked upon as extraneous bodies, with respect to the Gum, and as such they irritate the inside of that part in the same manner as the Pus of an abscess, an exfoliation of a bone, or any other extraneous body; and therefore produce the same symptoms, excepting only the formation of matter. If, therefore, these symptoms attend the cutting of the Teeth, there can be no doubt of the propriety of opening the way for them; nor is it ever, as far as I have observed, attended with any dangerous consequence.

OF THE
FORMATION and PROGRESS of the
ADULT TEETH.

HAVING now considered the first formation, and the progress of the Temporary Teeth, we shall next describe the formation of those Teeth which are to serve through life.

In this enquiry, to avoid confusion, I shall confine the description to the Teeth in the Lower-Jaw ; for the only difference between those in the two Jaws, is in the time of their appearance, and generally it is later in the Upper-Jaw. Their formation and appearance proceeds not regularly from the first *Incisor* backwards to the *Dens Sapientiæ*, but it begins at two points on each side of both Jaws, viz. at the first *Incisor*, and at the first *Molaris*. The Teeth between these two points make a quicker progress than those behind.

The Pulp of the first adult *Incisor*, and of the first adult *Molaris* begin to appear in a Fœtus of seven or eight months, and five or six months after birth the ossification

cation begins in them; soon after birth the Pulp of the second *Incisor* and *Cuspidatus* begin to be formed, and about eight or nine months afterwards they begin to ossify; about the fifth or sixth year the first *Bicuspis* appears; about the sixth or seventh the second *Bicuspis*, and the second *Molaris*; and about the twelfth, the third *Molaris*, or *Dens Sapientiæ*.

The first five may be called the permanent Teeth: they differ from the temporary in having larger fangs. The permanent *Incisores* and *Cuspidati* are much thicker and broader, and the *Molares* are succeeded by *Bicuspides*, which are smaller, and have but one fang.

All these permanent or succeeding Teeth are formed in distinct *Alveoli* of their own; so that they do not fill up the old sockets of the temporary Teeth, but have their new *Alveoli* formed as the old ones decay*.

The first *Incisor* is placed on the inside of the root of the corresponding temporary Tooth, and deeper in the Jaw. The second *Incisor* and the *Cuspidatus* begin to be formed on the inside, and somewhat under the temporary second *Incisor* and *Cuspidatus*. These three are all situated much in the same manner, with respect to the first set; but as they are larger, they are placed somewhat farther back in the circle of the Jaw.

* Vide Plate X. Fig. 1, 2, and 3.

The first *Bicuspis* is placed under, and somewhat farther back than the first temporary Grinder, or fourth Tooth of the child.

The second *Bicuspis* is placed immediately under the second temporary Grinder.

The second *Molaris* is situated in the lengthening tubercle in the Upper-Jaw, and directly under the Coronoid Process in the Lower.

The third *Molaris*, or *Dens Sapientiæ*, begins to form immediately under the Coronoid Process.

The first Adult *Molaris* comes to perfection, and cuts the Gum about the twelfth year of age, the second about the eighteenth, and the third, or *Dens Sapientiæ*, from the twentieth to the thirtieth: so that the *Incisores* and *Cuspidati* require about six or seven years, from their first appearance, to come to perfection; the *Bicuspidæ* about seven or eight; and the *Molares* about twelve.

It sometimes happens that a third set of Teeth appears in very old people; when this does happen, it is in a very irregular manner, sometimes only one, at other times more, and now and then a complete set comes in both Jaws. I never saw an instance of this kind

kind but once, and there two fore Teeth shot up in the Lower-Jaw.

I should suppose that a new Alveolar Process must be also formed in such cases, in the same manner as in the production of the first and second sets of Teeth. From what I can learn, the age at which this happens is generally about seventy. From this circumstance, and another that sometimes happens to women at this age, it would appear that there is some effort in nature to renew the body at that period.

When this set of Teeth which happens so late in life, is not complete, especially where they come in one Jaw, and not in the other, they are rather hurtful than useful; for in that case we are obliged to pull them out, as they only wound the opposite Gum.

THE

MANNER in which a TOOTH is formed.

THE body of the Tooth is formed first, afterwards the Enamel and Fangs are added to it. All the Teeth are produced from a kind of pulpy substance, which is pretty firm in its texture, transparent, excepting at the surface, where it adheres to the Jaw, and has at first the shape of the bodies of the Teeth which are to be formed from it *. These pulpy substances are very vascular, they adhere only at one part to the Jaw, viz. at the bottom of the cavity which is to form the socket; and at that place their vessels enter; so that they are prominent, and somewhat loose in the bony cavity which lodges them.

They grow nearly as large as the body of the Tooth before the ossification begins, and increase a little for some time after the ossification is begun. They are surrounded by a membrane, which is not connected with them, excepting at their root or surface of adhesion.

* Vide Plate XII. Fig. 4, 5, 6.

This membrane adheres by its outer surface all around the bony cavity in the Jaw, and also to the gum where it covers the Alveoli.

When the pulp is very young, as in the Fœtus of six or seven months, this membrane itself is pretty thick and gelatinous *. We can examine it best in a new-born child, and we find it made up of two *lamellæ*, an external and internal: the external is soft and spongy, without any vessels; the other is much firmer, and extremely vascular, its vessels coming from those that are going to the pulp of the Tooth: it makes a kind of Capfula for the pulp and body of the Tooth. While the Tooth is within the gum, there is always a mucilaginous fluid, like the Sinovia in the joints, between this membrane and the pulp of the Tooth.

When the Tooth cuts the gum, this membrane likewise is perforated; after which it begins to waste, and entirely gone by the time the Tooth is fully formed, for the lower part of the membrane continues to adhere to the neck of the Tooth, which has now risen as high as the edge of the gum.

* Vide Plate XII. Fig. 1, 2.

OSSIFICATION of a TOOTH upon the PULP.

THE beginning of the ossification upon the pulp is by one point, or more, according to the kind of Tooth. In the *Incisores* it is generally by three points, the middle one being the highest, and the first that begins to ossify. The *Cuspidatus* begins by one point only; the *Bicuspis* by two, one external, which is the first and the highest, and the other internal. The *Molares*, either in a child, or an adult, begin by four or five ossifications, one on each point, the external always the first *. Where the Teeth began to ossify at one point only, that ossification gradually advances till the Tooth is entirely completed †; but if there are more than one point of ossification, each ossification increases till their basis come in contact with one another, and there all unite into one ‡; after which they advance in growth as one ossification.

* Vide Plate X. Fig. 4, where some of the distinct ossifications may be observed.

† Vide Plate XIII. Fig. 1, 2, 3, &c.

‡ Vide Plate X. Fig. 5.

The ossifications in their progress become thicker and thicker where they first began, but increase faster on the edges of the Teeth; so as thence to become more and more hollow, and the cavity becomes deeper *. As the ossification advances, it gradually furrounds the Pulp till the whole is covered by bone, excepting the under surface: and while the ossifications advance, that part of the Pulp which is covered by bone is always more vascular than the part which is not yet covered †.

The adhesion of the Pulp to the new-formed Tooth, or bone, is very slight, for it can always be separated from it without any apparent violence, nor are there any vessels going from the one to the other; the place, however, where it is most strongly attached is round the edge of the bony part, which is the last part formed. When the bone has covered all the Pulp, it begins to contract a little, and becomes somewhat rounded, making that part of the Tooth which is called the neck; and from this place the fangs begin ‡. When the fangs form, they push up the bodies of the Teeth through the sockets, which waste, and afterwards through the Gum, which

* Vide Plate XIII. Fig. *a*, *b*, *c*, *d*, two rows of Incisors sawed down the middle, the highest of the child, the other of the adult; *e*, *f*, *g*, two rows of Grinders shewing the same circumstances.

† Vide Plate XII. Fig. 5, 6.

‡ Vide Plate XIII. Fig 1. 2, 3, &c.

also wastes, as has been explained upon the cutting of the Teeth; for before this time the rising of the Teeth is scarce observable, as the Pulp was at first nearly of the size of the body of the Tooth itself, and wasted nearly in proportion to the increase of the whole ossification.

The Pulp has originally no process answering to the fang *; but as the cavity in the body of the Tooth is filled up by the ossification, the pulp is lengthened into a fang. The fang grows in length, and rises higher and higher in the socket, till the whole body of the Tooth is pushed out. The socket, at the same time, contracts at its bottom, and grasps the neck, or beginning fang, adheres to it, and rises with it, which contraction is continued through the whole length of the socket as the fang rises; or the socket which contained the body of the Tooth, being too large for the fang, is wasted or absorbed into the constitution, and a new Alveolar portion is raised with the fang; whence in reality the fang does not sink, or descend into the Jaw. Both in the body, and in the fang of a growing Tooth, the extreme edge of the ossification is so thin, transparent, and flexible, that it would appear rather to be horny than bony, very much like the mouth or edge of the shell of a snail when it is growing: and indeed it would

* Vide Plate XII. Fig. 1, 4, 5, and 6.

seem to grow much in the same manner*, and the ossified part of a Tooth would seem to have much the same connection with the pulp as a snail has with its shell.

As the Tooth grows, its cavity becomes gradually smaller, especially towards the point of the fang. In tracing the formation of the fang of a Tooth, we hitherto have been supposing it to be single, but where there are two, or more, it is somewhat different, and more complicated.

When the body of a Molares is formed, there is but one general cavity in the body of the Tooth, from the brim of which the ossification is to shoot, so as to form two or three fangs †. If two only, then the opposite parts of the brim of the cavity of the Tooth shoot across where the Pulp adheres to the Jaw, meet in the middle, and thereby divide the mouth of the cavity into two openings ‡; and from the edges of these two openings the two fangs grow §.

We often find that a distinct ossification begins in the middle of the general cavity upon the root of the

* Vide Plate XIII. Fig. 1, 2, 3, or Fig.

† Vide Plate XIII. Fig. 1, *a a*.

‡ Vide Plate XIII. Fig. *b*.

§ Vide Plate XIII. Fig. *c d e*.

Pulp, and two processes coming from the opposite edges of the bony shell join it; which answers the same purpose.

When there are three fangs, we see three processes coming from so many points of the brim of the cavity, which meet in the center, and divide the whole into three openings *; and from these are formed the three fangs †. We often find the fangs forked at their points, especially in the *Bicuspides*. In this case, the sides of the fang as it grows, come close together in the middle, making a longitudinal groove on the outside; and this union of the opposite sides divides the mouth of the growing fang into two orifices, from which the two points are formed.

By the observations which I have made in unravelling the texture of the Teeth, when softened by an acid, and from observing the disposition of the red parts in the Tooth of growing animals, interruptedly fed with madder, I find that the bony part of a Tooth is formed of *Lamellæ*, placed one within another. The outer *Lamellæ* is the first formed, and is the shortest: the more internal *Lamellæ* lengthen gradually towards the fang, by which means, in proportion as the Tooth

* Vide Plate XIII. Fig. *f*, *g*.

† Vide Plate XIII. Fig. *b*, *i*, *k*.

grows

grows longer, its cavity grows smaller, and its sides grow thicker*.

How the earthy and animal substance of the Tooth is deposited on the surface of the pulp is not perhaps to be explained.

* Vide Plate XII. Fig. 7, 8.

OF THE

FORMATION of the ENAMEL.

IN speaking of the Enamel we postponed treating of its Formation, till it could be more clearly understood; and now we shall previously describe some parts which we apprehend to be subservient to its formation, much in the same manner as the Pulp is to the body of the Tooth.

From its situation, and from the manner in which the Teeth grow, one would imagine that the Enamel is first formed; but the bony part begins first, and very soon after the Enamel is formed upon it. There is another pulpy substance opposite to that which we have described; it adheres to the inside of the Capsula, where the Gum is joined to it, and its opposite surface lies in contact with the basis of the above described Pulp, and afterwards with the new formed basis of the Tooth: whatever eminences or cavities the one has, the other has the same, but reversed, so that they are moulded exactly to each other.

In

In the *Incisores* it lies in contact not with the sharper cutting edge of the Pulp, or Tooth, but against the hollowed inside of the Tooth; and in the *Molares* it is placed directly against their base, like a Tooth of the opposite Jaw. It is thinner than the other Pulp, and decreases in proportion as the Teeth advance. It does not seem to be very vascular. The best time for examining it is in a Fœtus of seven or eight months old.

In the granivorous animal, such as the horse, cow, &c. whose Teeth have the Enamel intermixed with the bony part*, and whose Teeth, when forming, have as many interstices as there are continuations of the Enamel, we find processes from the Pulp passing down into those interstices as far as the Pulp which the Tooth is formed from, and there coming into contact with it.

After the points of the first described Pulp are begun to ossify, a thin covering of enamel is spread over them, which increases in thickness till some time before the Tooth begins to cut the Gum.

The Enamel appears to be secreted from the Pulp above described, and perhaps from the Capsula which incloses the body of the Tooth. That it is from the Pulp and Capsula seems evident in the horse, ass, ox, sheep, &c. therefore we have little reason to doubt of

* Vide Plate XIV. Fig. 19, 20.

it in the human species. It is a calcareous earth, probably dissolved in the juices of our body, and thrown out from these parts which act here as a gland. After it is secreted, the earth is attracted by the bony part of the Tooth, which is already formed; and upon that surface it crystallizes.

The operation is similar to the formation of the shell of the egg, the stone in the kidneys and bladder, and the gall stone. This accounts for the striated crystallized appearance which the Enamel has when broken, and also for the direction of these *Striæ* *.

The Enamel is thicker at the points and basis than at the neck of the Teeth, which may be easily accounted for from its manner of formation; for if we suppose it to be always secreting, and laid equally over the whole surface, as the Tooth grows, the first formed will be the thickest; and the neck of the Tooth, which is the last formed part inclosed in this Capsula, must have the thinnest coat; and the fang, where the *Periosteum* adheres, and leaves no vacant space, will have none of the Enamel.

* The Author has made many experiments on the formation of different *Calculi*, and finds they are formed by crystallization, which were communicated to his brother, and taught by him to his pupils in 1761, and which he proposes to give to the Public as soon as his time will permit.

At

At its first formation it is not very hard ; for by exposing a very young Tooth to the air, the Enamel cracks, and looks rough : but by the time that the Teeth cut the Gum, the Enamel seems to be as hard as ever it is afterward ; so that the air seems to have no effect in hardening it.

MANNER of SHEDDING of TEETH.

AN opinion has commonly prevailed, that the first set of Teeth are pushed out by the second; this, however, is very far from being the case: and were it so, it would be attended with a very obvious inconvenience; for, were a Tooth pushed out by one underneath, that Tooth must rise in proportion to the growth of the succeeding one, and stand in the same proportion above the rest. But this circumstance never happens: neither can it; for, the succeeding Teeth are formed in new and distinct sockets, and generally the *Incisores* and the *Cuspidati* of the second set are situated on the inside of the corresponding teeth of the first set*; and we find, that in proportion to the growth of the succeeding Teeth, the fangs of the first set decay, till the whole of the fang is so far destroyed, that nothing remains but the neck, or that part of the fang to which the Gum adheres †, and then the least force pushes the Tooth out. It would be very natural to suppose, that this

* Vide Plate X. Fig. 2, 3.

* Vide Plate XV. which shews the gradual decay in the single and double Teeth, and also in one Grinder of a horse.

was owing to a constant pressure from the rising Teeth against the fangs or sockets of the first set: but it is not so; for, the new Alveoli rise with the new Teeth, and the old Alveoli decay in proportion as the fangs of the old Teeth decay, and when the first set falls out, the succeeding Teeth are so far from having destroyed, by their pressure, the parts against which they might be supposed to push, that they are still inclosed, and covered by a complete bony socket. From this we see, that the change is not produced by a mechanical pressure, but is a particular process in the animal œconomy.

I have seen two or three Jaws where the second temporary Grinders were shedding in the common way, without any Tooth underneath; and in one Jaw, where both the Grinders were shedding, I met with the same circumstance.

A remarkable instance of this sort occurred to me in a lady who desired me to look at a loose Tooth, which I found was the last temporary Tooth not yet shed. I desired that it might be drawn out, and told her it was of no use, and could not by any art be fixed, as it was one of the Teeth that is naturally shed, and that another might come in its place: however she was disappointed.

These cases prove evidently, that in shedding, the first Teeth are not pushed out by the second set, but that they grow loose, and fall out of their own accord. That the succeeding Teeth have some influence on the shedding of the temporary set is proved by those very cases; since in one of the first mentioned the person was above twenty years of age, and in the other the lady was thirty; and it is reasonable to believe, that the shedding of these Teeth was so late in those instances, from the want of the influence, whatever it is, of the new Teeth. When the *Incisores* and *Cuspidati* of the new set are a little advanced, but long before they appear through their bony sockets, there are small holes leading to them on the inside, or behind the temporary sockets and Teeth; and these holes grow larger and larger, till at last the body of the Tooth passes quite through them.

OF THE
GROWTH of the TWO JAWS.

AS a knowledge of the manner in which the two Jaws grow, will lead to the better understanding the shedding of the Teeth; and as the Jaws seem to differ in their manner of growing, from other bones, and also vary according to the age, it will be here proper to give some account of their growth.

In a Fœtus three or four months old, we have described the marks of four or five Teeth, which occupy the whole length of the Upper-Jaw, and all that part of the Lower which lies before the Coronoid Process, for the fifth Tooth is somewhat under that process*.

These five marks become larger, and the Jaw bones of course increase in all directions, but more considerably backwards; for in a Fœtus of seven or eight months, the marks of six Teeth in each side of both Jaws are to be observed, and the sixth seems to be in the place where the fifth was; so that in these last four

* Vide Plate VIII. Fig. 1, 2.

months the Jaw has grown in all directions in proportion to the increased size of the Teeth, and besides has lengthened itself at its posterior end as much as the whole breadth of the socket of that sixth Tooth *.

The Jaw still increases in all points till twelve months after birth, when the bodies of all the six Teeth are pretty well formed ; but it never after increases in length between the symphysis and the sixth Tooth ; and from this time too, the Alveolar Process, which makes the anterior part of the arches of both Jaws, never becomes a section of a larger circle, whence the lower part of a child's face is flatter, or not so projecting forwards as in the adult†.

After this time the Jaws lengthen only at their posterior ends ; so that the sixth Tooth, which was under the Coronoid Process in the Lower-Jaw, and in the tubercles of the Upper-Jaw of the Fœtus, is at last, *viz.* in the eighth or ninth year, placed before these parts ; and then the seventh Tooth appears in the place which the sixth occupied, with respect to the Coronoid Process, and tubercle ; and about the twelfth or fourteenth year, the eighth Tooth is situated where the seventh was placed.

* Vide Plate VIII. Fig. 3, 4, 5, 6, for the general increase of the Jaws, but more particularly backwards.

† Vide Plate VIII. Fig. 7, for these facts.

At the age of eighteen, or twenty, the eighth Tooth is found before the Coronoid Process in the Lower-Jaw, and under, or somewhat before the tubercle in the Upper-Jaw, which tubercle is no more than a succession of sockets for the Teeth till they are completely formed.

In a young child the cavity in the temporal bone for the articulation of the Jaw is nearly in a line with the Gums of the Upper-Jaw; and for this reason the Condyle of the Lower-Jaw is nearly in the same line*; but afterwards, by the addition of the Alveolar Process and Teeth, the line of the Gums in the Upper-Jaw descends considerably below the articular cavity; and for that reason the Condylloid Process is then lengthened in the same proportion.

In old people who have lost all their Teeth, the articulation comes again into the same line with the Gums of the Upper-Jaw†; but in the Lower-Jaw, the Condyles cannot be diminished again for accommodating it to the Upper, so that it necessarily projects beyond the Gums of the Upper-Jaw at the fore part. When the mouth is shut, the projection of the Jaw at the chin, fits the two Jaws to each other at that place

* Vide Plate VIII. Fig. 11.

† Vide Plate VII.

where

where the Grinders were situated, and where the strength of mastication lies ; for if the chin was not further from the center of motion than the Gums of the Upper-Jaw, at the fore part, the Jaws, in such people as have lost all their Teeth, would meet in a point at the fore part, like a pair of pinchers, and be at a considerable distance behind*.

* Vide Plate VII.

T H E

THE

REASON for the SHEDDING of the TEETH.

AS the shedding of the Teeth is a very singular process in the animal œconomy, many reasons have been assigned for it; but these reasons have not carried along with them that conviction which is desired. Authors have not fully considered the appearances which naturally explain themselves; nor have they considered the advantages necessarily arising from the size and construction of only such a number as the first set; nor have they considered fully the disadvantages that such size and construction would have, if continued when it is necessary to have a greater number, which is the case with the adult.

We shall consider these advantages in a child where the shedding Teeth are all completely formed, which will be setting them in the clearest point of light; and also, the disadvantages that would occur, if in the adult these were not changed for another set somewhat different.

If the child had been so contrived, as not to have required Teeth till the time of the second set's appearing, there would have been no occasion for a new set: but the Jaw-bones being considerably smaller in children than in adults, and it being necessary that they should have two Grinders, there is not room for *Incisores* and *Cuspidati* of sufficient size to serve through life; and the first formed Grinders having necessarily too small fangs, and the Jaw increasing at the back part only, these two Grinders would have been protruded too far forwards, and at too great a distance from the center of motion. This variation in the size of the Teeth is likewise a reason why the second set are not formed in the sockets of the first; and why the old sockets are destroyed.

These circumstances with regard to the shedding of the Teeth, contradict the notion of the second set being made broader and thicker, by the resistance they meet with in pushing out the first. For were we, on a partial view of the subject, to admit the supposition, the *Bicuspidates* would effectually overturn our hypothesis; because here the second set are much smaller than the first, and yet the resistance would be greater to them than to the *Incisores*.

From the manner in which the Teeth are shed, it is evident that drawing a temporary Tooth, for the easier
pro-

protrusion of the one underneath, will be of no great service; for in general it falls out before the other can touch it. But it is often of much more service to pull out the neighbouring, or adjacent temporary Tooth; for we must be convinced by what has been advanced with regard to the changes in size, that excepting the whole were to shed at the same time, or the order of shedding, viz. from before backwards, were to be inverted, that the second set of *Incisores* and *Cuspidati* must be pinched in room, till the Grinders are also shed: and therefore we find it often of use to draw a temporary Tooth, that is placed further back; and it would, perhaps, be right upon the whole, always to draw, at least the first Grinder; and, perhaps, some time after, the second Grinder also.

OF THE

CAVITY filling up as the TEETH wear down.

A TOOTH very often wears down so low, that its cavity would be exposed, if no other alteration were produced in it. To prevent this, nature has taken care that the bottom part of the cavity should be filled up by new matter, in proportion as the surface of the Teeth is worn down. This new matter may be easily known from the old; for when a Tooth has been worn down almost to the neck, a spot may always be seen in the middle, which is more transparent, and at the same time of a darker colour, (occasioned, in some measure, by the dark cavity under it) and is generally softer than the other*. Any person may be convinced of the truth of these observations, by taking two Teeth of the same class, but of very different ages, one just completely formed, the other worn down almost to its neck. In the last he will observe the dark spot in the center; and if as much is cut off from the complete

* Vide Plate XIV. Fig. 24, 25.

Tooth as hath been worn off the old one, the cavity of the young Tooth will be found cut through; and on examining the other, its cavity will be found filled up below that surface. Now this observation contradicts the idea of the hole leading into the cavity of the Tooth being closed up; and what is still a further proof of it, I have been able to inject vessels in the cavities of the Teeth in very old people when the Alveolar Process has been gone, and the Teeth very loose in the Gum.

Old people are often found to have very good sets of Teeth, only pretty much worn down. The reason of this is, that such people never had any disorder in their Teeth, or Alveolar Processes, sufficient to occasion the falling of one Tooth. For if by accident one Tooth is lost, the rest will necessarily fail in some degree, even though they are sound, and likely to remain so, had not this accident happened; and this weakening cause is greater, in proportion to the number that are lost. From this observation, we see that the Teeth support one another.

OF THE

CONTINUAL GROWTH of the TEETH.

IT has been asserted that the Teeth are continually growing, and that the abrasion is sufficient to keep them always of the same length; but we find that they grow at once to their full length, and that they gradually wear down afterwards; and that there is not even the appearance of their continuing to grow. The Teeth would probably project a little farther out of the Gum, if they were not opposed by those in the opposite Jaw; for in young people, who had lost a Tooth before the rest had come to their full length, I have seen the opposite Tooth project a little beyond the rest, before they were at all worn down. It may be further observed, that when a Tooth is lost, the opposite one may project from the disposition of the Alveolar Process to rise higher, and fill up at the bottom of the sockets; and the want of that natural pressure seems to give that disposition to these processes, which is best illustrated in those Teeth which are formed deeper in their sockets than usual. As a proof that the Teeth continue growing, it has been said that the space
of

of a fallen Tooth is almost filled up by the increased thickness of the two adjacent Teeth, and the lengthening of that which is opposite. There is an evident fallacy in the case; either the observations have been made upon such Jaws as above described, or the appearances have not been examined with sufficient accuracy; for when the space appears to have become narrow by the approximation of the two adjacent Teeth, it is not owing to any increase of their breadth, but to their moving from that side where they are well supported, to the other side, where they are not. For this reason they get an inclined direction; and I observe it extends to the several adjacent Teeth in a proportional less degree, and affects those which are behind*, more than those which are before the vacant space.

In the Lower-Jaw the back Teeth are not fixed perpendicularly, but all inclined forward; and the depression of the Jaw increases this position: the action of the Teeth, when thrown out of the perpendicular, has also a tendency to increase that oblique direction, as a pair of scissars, in cutting, pushes every thing forward, or from the center of motion: therefore this alteration, I think, is most commonly observable in the Lower-Jaw.

* Vide Plate XVI. Fig. 1, b, c.

And that Teeth are not actually always growing in breadth, must be obvious to every person who considers, that in many people, through life, the Teeth stand so wide from each other, that there are considerable spaces between them; which could not be the case if they were always growing in thickness.

We might add too, that according to the hypothesis, the *Dens Sapiientiæ* should grow to an enormous size backward, because there it has no check from pressure; and in people where the *Dens Sapiientiæ* is wanting in one Jaw, which is very common, it should grow to an uncommon length in the opposite Jaw, for the same reason. But neither of these things happens.

I need hardly take notice, that when a Tooth has lost its opposite, it will in time become really so much longer than the rest, as the others grow shorter by abrasion; and I observe that the Tooth which is opposite to the empty space, becomes in time not only longer for the above-mentioned reason, but more pointed. The apex falls into the void space, and the two sides are rubbed away against the sides of the two approaching Teeth next to that space.

The manner of their formation likewise shews that Teeth cannot grow beyond a certain limited size. To illustrate this I may observe, that I have often, in the

the dead body of adults, found the left *Cuspidatus* of the Upper-Jaw, with its points scarcely protruding out of the Alveolar Process, though the Tooth was completely formed, and longer than the other by the whole point, which in that other was worn away *. This Tooth, at its first formation, had been deeper in the Jaw than what is common ; and after it had grown to the ordinary size, it grew no longer, though it had not the resistance of the opposite Teeth to set bounds to its increase : yet commonly in these cases the Tooth continues to project further and further through the Gum ; though this is not owing to its growing longer, but to the socket filling up behind it, and thereby continuing to push it out by slow degrees.

* Vide Plate VIII. Fig. 8.

OF THE
SENSIBILITY of TEETH.

THE Teeth would seem to be very sensible; for they appear to be subject to great pain, and are easily and quickly affected by either heat or cold.

We may presume that the bony substance itself, is not capable of conveying sensations to the mind, because it is worn down in mastication, and occasionally worked upon by operators in living bodies, without giving any sensation of pain in the part itself.

In the cavity of a Tooth it is well known that there is exquisite sensibility; and it is likewise believed, that this is owing to the nerve in that cavity. This nerve would seem to be more sensible than nerves are in common; as we do not observe the same violent effects from any other nerve in the body being exposed either by wound, or sore, as we do from the exposure of the nerve of a Tooth. Perhaps the reason of the intenseness, as well as the quickness of the sense of heat and cold in the Teeth, may be owing to their communicating these to the nerve sooner than any other part of the body.

SUPERNUMERARY TEETH.

WE often meet with Supernumerary Teeth ; and this, as well as some other variations, happens oftener in the Upper than in the Lower-Jaw, and, I believe, always in the *Incisores* and *Cuspidati*. I have only met with one instance of this sort, and it was in the Upper-Jaw of a child about nine months old : there were the bodies of two Teeth, in shape like the *Cuspidati*, placed directly behind the bodies of the two first permanent *Incisores* ; so that there were three Teeth in a row, placed behind one another, viz. the temporary *Incisor*, the body of the permanent *Incisor*, and that supernumerary Tooth. The most remarkable circumstance was, that these Supernumerary Teeth were inverted, their points being turned upwards, and bended by the bone which was above them not giving way to their growth, as the Alveolar Process does.

It often happens that the *Incisores* and *Cuspidati*, in the Upper-Jaw especially, are so irregularly placed, as to give the appearance of a double row. I once saw a remarkable instance of this in a boy ; the second *In-*

cisor in each side was placed farther back than what is common, and the *Cuspidatus* and first *Incisor* closer together, than if the second *Incisor* had been directly between them; so that the appearance gave an idea of a second row of Teeth.

This happens only in the adult set of Teeth, and is owing to there not being room in the Jaw for this second set, the Jaw-Bone being formed with the first set of Teeth, and never increasing afterwards; so that if the adult set does not pass further back, they must over-lap each other, and give the appearance of a second row.

O F T H E
U S E of the T E E T H so far as they affect the
V O I C E.

TH E Teeth serve principally for mastication ; and that use need not be farther explained.

They serve likewise a secondary, or subordinate purpose ; giving strength and clearness to the sound of the voice, as is evident from the alteration produced in speaking, when the Teeth are lost.

This alteration, however, may not depend entirely upon the Teeth, but, in some measure, on the other organs of the voice having been accustomed to them ; and therefore when they are gone, those other organs may be put out of their common play, and may not be able to adapt themselves so well to this new instrument. Yet I believe that habit in this case has no great effect ; for those people seldom or never to get the better of the defect ; and young children, who are shedding their Teeth, and are, perhaps, without any Fore Teeth for half a year or more, always have that defect in their
voice,

voice, till the new Teeth come ; and as these grow the voice becomes clear again.

This use seems to be entirely in the Fore Teeth ; for the loss of one of these makes a great alteration, and the loss of two or three Grinders seems to have no sensible effect. As an argument for the use of the Teeth in modifying the sound of the voice, we may observe, that the Fore Teeth come at a time when the child begins to articulate sounds, and at that time they are so loose in the gums, that they can be of very little service in mastication.

Every defect in speech, arising from this defect in the organ, is generally attended with what we call a lisp. People who have lost all their Teeth, and most old people for that reason, lose, in a great measure, their voice. This arises partly from the loss of the Fore Teeth, but principally from the loss of all the Teeth, and of the Alveolar Processes of both Jaws, by which means the mouth becomes too small for the tongue, and the lips and cheeks become flaccid ; inasmuch that the nicer movements of these parts, in the articulation of sounds, are obstructed ; and thence the words and syllables are indistinctly pronounced, and flurred, or run into one another.

Under what CLASS do the HUMAN TEETH
come.

NATURAL Historians have been at great pains to prove from the Teeth, that man is not a carnivorous animal; but in this, as in many other things, they have not been accurate in their definitions; nor have they determined what a carnivorous animal is.

If they mean an animal that catches and kills his prey with his Teeth, and eats that flesh of the prey just as it is killed, they are in the right; man is not in this sense a carnivorous animal, and therefore he has not Teeth like those of a Lion; and this, I presume, is what they mean.

But if their meaning were that the Human Teeth are not fitted for eating meat that has been caught, killed, and dressed by art, in all the various ways that the superiority of the human mind can invent, they are in the wrong. Indeed, from this confined way of thinking it would be hard to say what the human Teeth are fitted for; because, by the same reasoning, man is not a graminivorous animal, as his Teeth are not fitted for pulling vegetable food, &c. They are not made like those of cows or horses, for example.

The

The light in which we ought to view this subject is, that man is a more perfect or complicated animal than any other; and is not made like others, to come at his food by his Teeth, but by his hands, directed by his superior ingenuity; the Teeth being given only for the purpose of chewing the food, in order to its more easy digestion: and they, as well as his other organs of digestion, are fitted for the conversion of both animal and vegetable substances into blood; and thence he is able to live in a much greater variety of circumstances than any other animal, and has more opportunities of exercising the faculties of his mind. He ought, therefore, to be considered as a compound, fitted equally to live upon flesh and upon vegetables.

OF THE
DISEASES of the TEETH.

THE Teeth are subject to diseases as well as other parts of the body. Whatever the disorder is that affects them, it is generally attended with pain; and from this indeed we commonly first know that they are affected.

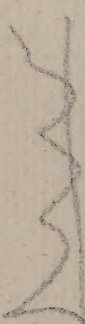
Pain in the Teeth proceeds, I believe, in a great measure, from the air coming into contact with the nerve in the cavity of the Tooth; for we seldom see people affected with the Tooth-ach, but when the cavity is exposed to the air.

It is not easy to say by what means the cavity comes to be exposed.

The most common disease to which the Teeth are subject, begins with a small, dark coloured speck, generally on the side of the Tooth where it is not exposed to pressure; from what cause this arises is hitherto unknown. The substance of the Tooth thus discoloured,

R. gradually

gradually decays, and an opening is made into the cavity. As soon as the air is thereby admitted, a considerable degree of pain arises, which is probably owing to the admission of the air, as it may be prevented by filling the cavity with lead, wax, &c. This pain is not always present; the food, and other substances, perhaps fill up the hole occasionally, and prevent the access of the air, and of consequence the pain, during the time they remain in it. When an opening is made into the cavity of the Tooth, the inside begins to decay, the cavity becomes larger, the breath at the same time often acquires a putrid *Fætor*, the bone continues to decay till it is no longer able to support the pressure of the opposite Tooth, it breaks and lays the cavity open. We have not as yet found any means of preventing this disease, or of curing it; all that can be done, is to fill the hole with lead, which prevents the pain, and retards the decay; but after the Tooth is broken, this is not practicable; and for that reason it is then best to extract it.



It would be best of all to attempt the extraction of a Tooth by drawing it in the direction of its axis: but that not being practicable by the instruments at present in use, which pull laterally, it is the next best to draw a Tooth to that side where the Alveolar Process is weakest; which is the inside, in the two last grinders on each side of the Lower-Jaw, and the outside in all the others.

It

It generally happens in drawing a Tooth, that the Alveolar Process is broken, particularly when the Grinders are extracted; but this is attended with no bad consequences, as that part of the Alveolar Process from which the Tooth was extracted always decays.

In drawing a Tooth, the patient complains of a disagreeable jarring noise, which always happens when any thing grates against the bones of the head.

O F

CLEANING the TEETH.

FROM what was said of the nature and use of the Enamel, it is evident, that whatever is capable of destroying it, must be hurtful; therefore all acids, gritty powders, and injudicious methods of scaling the Teeth are prejudicial: but simply scaling the Teeth, that is, clearing them of the stony concretions which frequently collect about their necks, while nothing is scraped off but that adventitious substance, is proper and useful. If not removed by art, the quantity of the stony matter is apt to increase, and to affect the gum. This matter first begins to form on the Tooth near to the Gum; but not in the very angle, because the motion of the Gum commonly prevents the accumulation of it at this part. I have seen it cover not only the whole Tooth, but a great part of the Gum: in this case there is always an accumulation of a very putrid matter, frequently considerable tenderness and ulceration

6

tion

tion of the Gum, and scaling becomes absolutely necessary *.

* The animal fluids, when out of the course of the general circulation, especially when they stagnate in cavities, are apt to deposit an absorbent earth, and form concretions. This earth is sometimes contained in the fluids; and is only deposited; as in the formation of the stone in the urinary passages: in some cases, perhaps, the fluids undergo a change, by which the earth is first formed, and afterwards deposited. This deposition takes place particularly in weakened parts, or where the circulation is languid, or where there are few arteries, such as about joints and tendons; as if it were intended to strengthen these parts, if they should at any time give way; for if an artery, for instance, is overcome by the action of the heart, and unnaturally dilated, its coats have commonly these concretions formed every where in their interstices. The same thing happens also in the coats of incysted tumors, which are constantly distended; in cases of distentions of the Tunica Vaginalis Testis, &c. It is also apt to take place in parts which have lost their natural functions; as in the coats of the eye in cases of blindness, and in diseased lymphatic glands, &c. and where the living power is diminished in the system, as in the arteries, membranes, &c. of old people; and in some particular habits, as in those who are affected by the gout.

The same sort of deposition takes place likewise where there is any substance with such properties as render it a fit *Basis* for crystallization; as when extraneous bodies are lodged in the bladder: whence such bodies are so often found to form the *Nucleus* of a stone. The same thing happens in the bowels of many animals; whence the *Nucleus* of intestinal concretions, or bezoars, is commonly a nail, or some indigestible substance which had been swallowed. The crust, which collects upon the Teeth, seems to be a crystallization of the same nature.

O F

TRANSPLANTING the TEETH.

FROM considering the almost constant variety of the size and shape of the same class of Teeth in different people, it would appear almost impossible to find the Tooth of one person that should fit, with any degree of exactness, the socket of another; and this observation is supported, and indeed would seem to be proved by observing the Teeth in skeletons. Yet we can actually transplant a Tooth from one person to another, without great difficulty, nature assisting the operation, if it is done in such a way that she can assist; and the only way in which nature can assist, with respect either to size or shape, is by having the fang of the transplanted Tooth rather smaller than the socket. The socket, in this case grows to the Tooth. If the fang is too large, it is impossible indeed to insert it at all in that state; however, if the fang should be originally too large, it may be made less; and this seems to answer the purpose as well.

The success of this operation is founded on a disposition in all living substances, to unite when brought in-

to

contact with one another ; although they are of a different structure ; and even although the circulation is only carried on in one of them.

This disposition is not so considerable in the more perfect or complex animals, such as quadrupeds, as it is in the more simple or imperfect ; nor in old animals, as in young : for the living principle in young animals, and those of simple construction, is not so much confined to, or derived from one part of the body ; so that it continues longer in a part separated from their bodies, and even would appear to be generated in it for some time ; while a part, separated from an older, or more perfect animal, dies sooner, and would appear to have its life entirely dependent on the body from which it was taken.

Taking off the young spur of a cock, and fixing it to his comb, is an old and well known experiment.

I have also frequently taken out the *Testis* of a cock and replaced it in his belly, where it has adhered, and has been nourished ; nay, I have put the *Testis* of a cock into the belly of a hen with the same effect.

In like manner a fresh Tooth, when transplanted from one socket to another, becomes to all appearance a part of that body to which it is now attached, as
 4 much

much as it was of the one from which it was taken; while a Tooth which has been extracted for some time, so as to lose the whole of its life, will never become firm or fixed; the sockets will also in this case acquire the disposition to fill up, which they do not in the case of the insertion of a fresh Tooth.

These appearances shew that the living principle exists in the several parts of the body, independent of the influence of the brain, or circulation, and that it subsists by these, or is indebted to them for its continuance; and in proportion as animals have less of brain and circulation, the living power has less dependence on them, and becomes a more active principle in itself; and in many animals there is no brain nor circulation, so that this power is capable of being continued equally by all the parts themselves, such animals being nearly similar in this respect to vegetables.

Fig. 1.

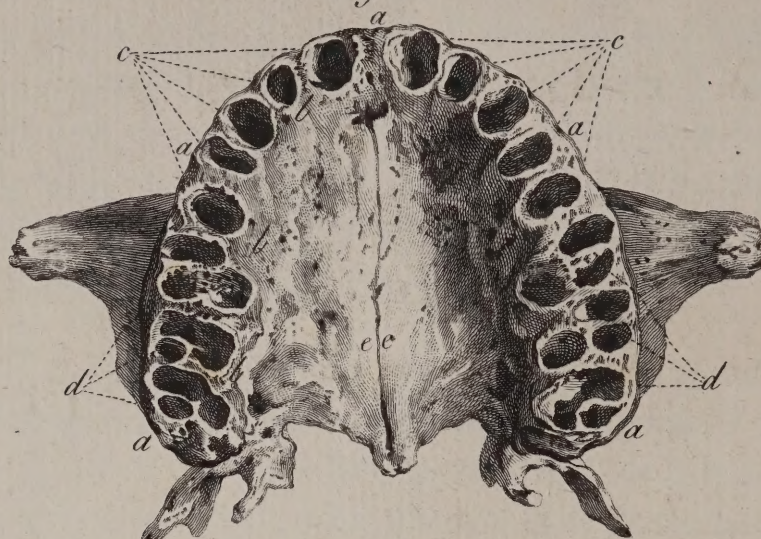
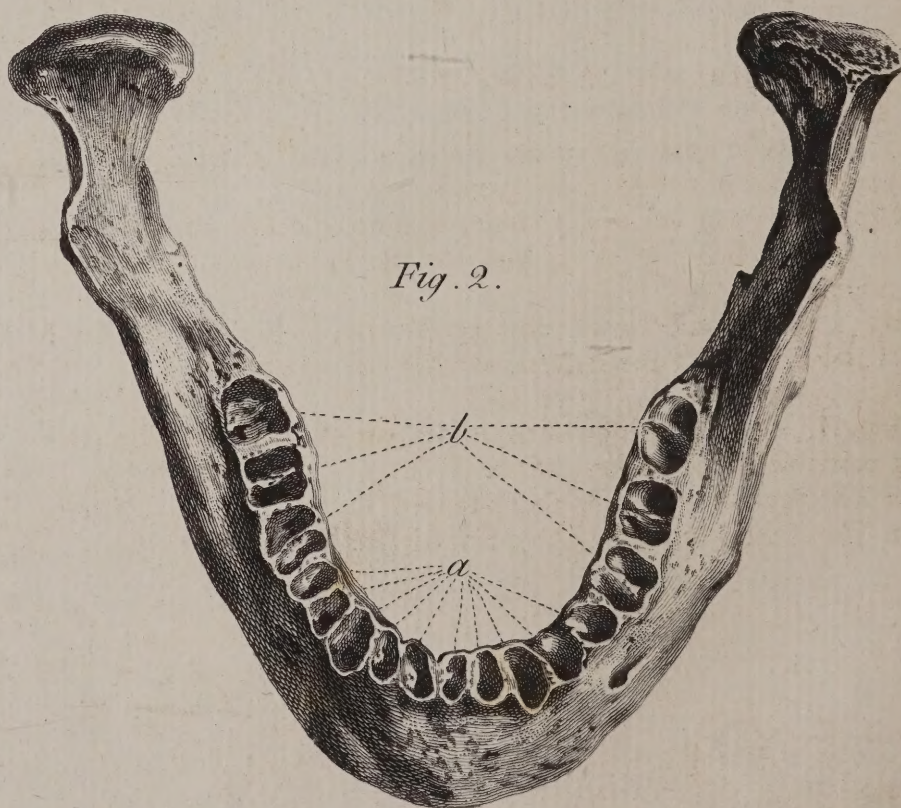


Fig. 2.



EXPLANATION

OF THE

PLATES.

PLATE I.

FIG. I.

A Representation of the under-side of the Upper-Jaw, without the Teeth.

a a a a a The outer line of the circle, or what is commonly called the outer plate of the Alveolar process.

b b b The inner line of the circle, commonly called the inner plate.

c c The 10 single Sockets, viz. for the Incisores, Cuspidati, and Bicuspides.

d d The 3 double Sockets for the Molar, or triple-fanged Teeth. The two first have three sockets, and the last only two.

Fig. II. A representation of the upper part of the Lower-Jaw, shewing particularly the Sockets of the Teeth.

a The Sockets of the ten single-fanged Teeth.

b The sockets of the 3 double-fanged Teeth.

S

PLATE

P L A T E II.

A Sketch of the Head to explain what was said of the motions of the Lower-Jaw.

A The Section of the Head which was made to bring the Articulation of the Lower-Jaw into view.

B Lower-Jaw.

C The condyle of the Lower-Jaw.

D The occipital condyle of the Head.

E F The Digastric Muscle.

E Its origin.

F Its insertion.

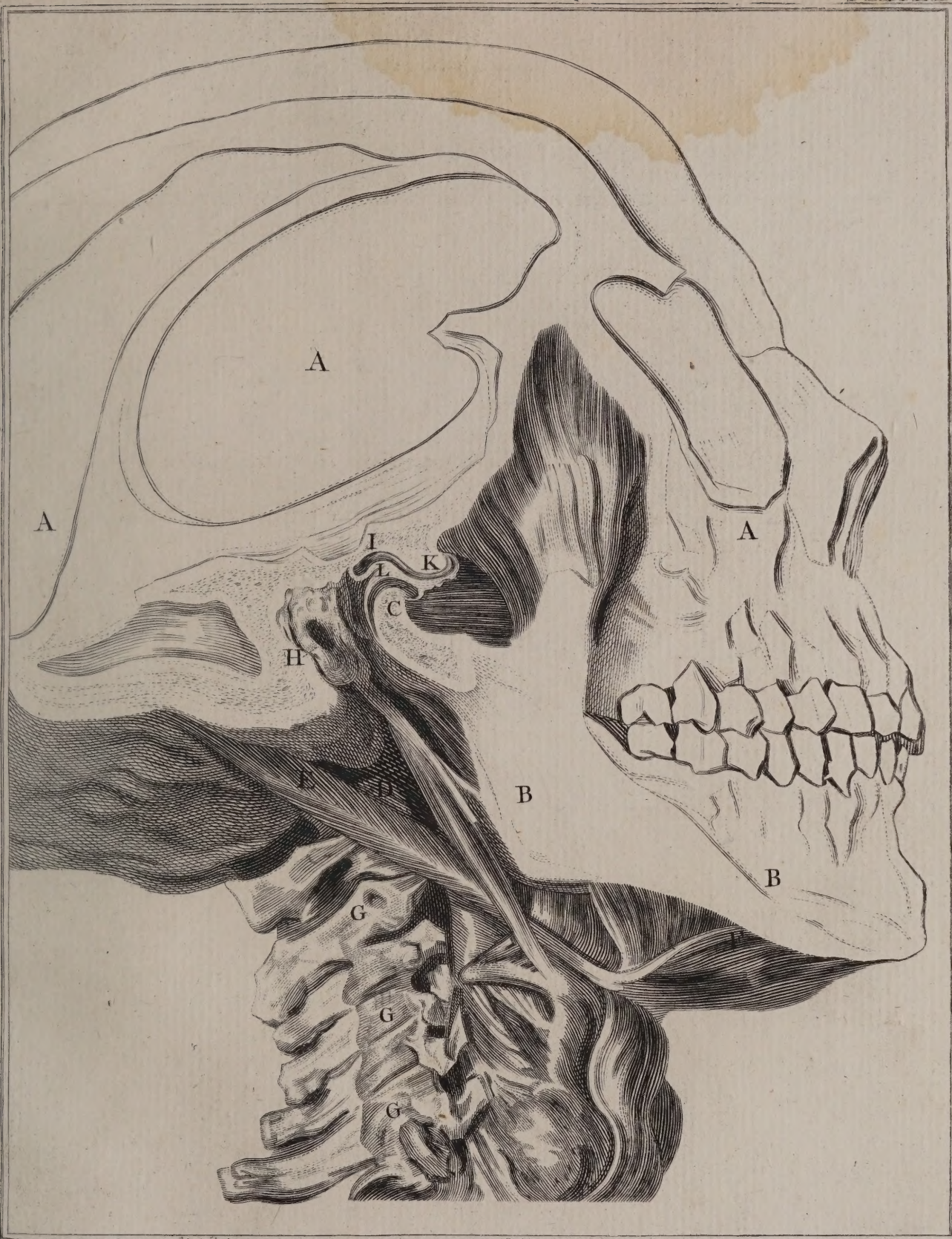
G G G The *Vertebrae* of the Neck.

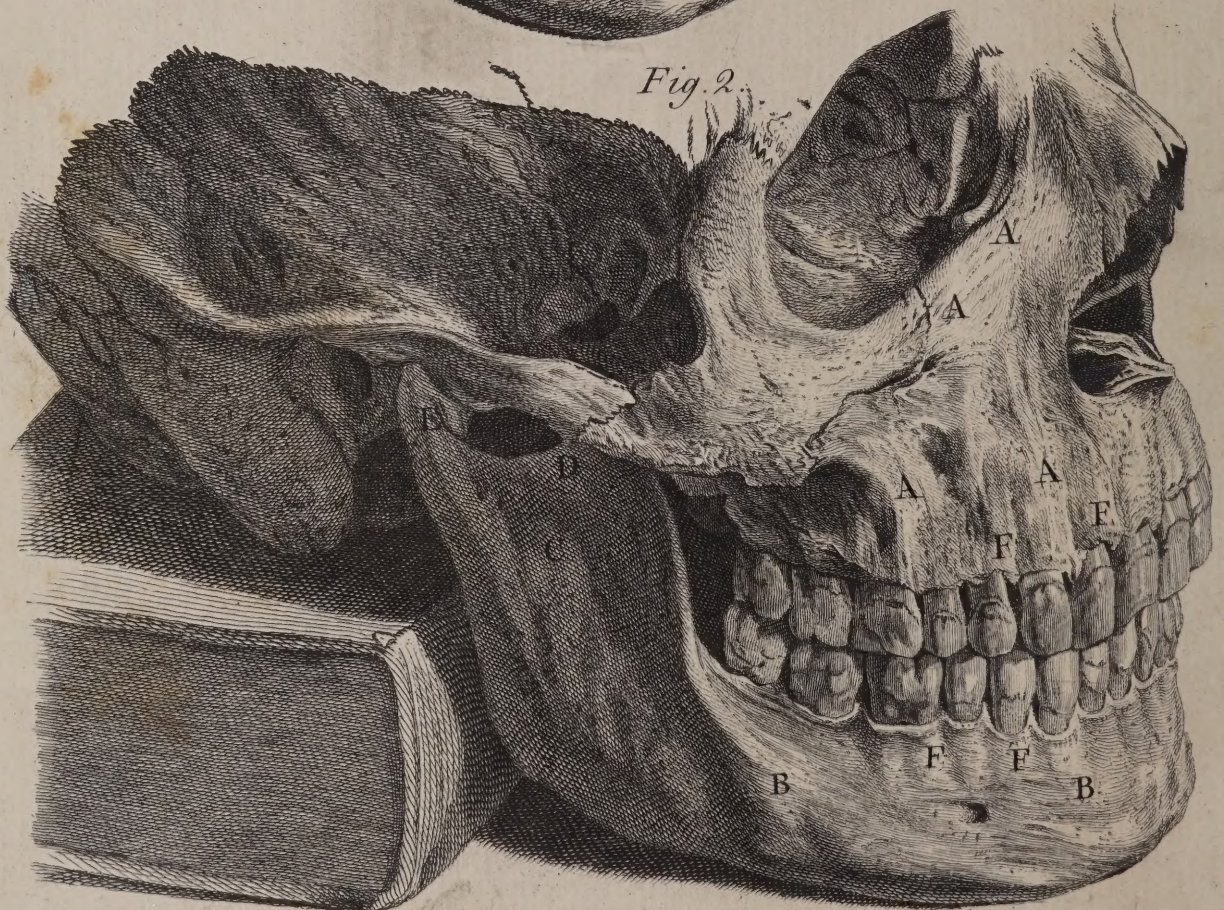
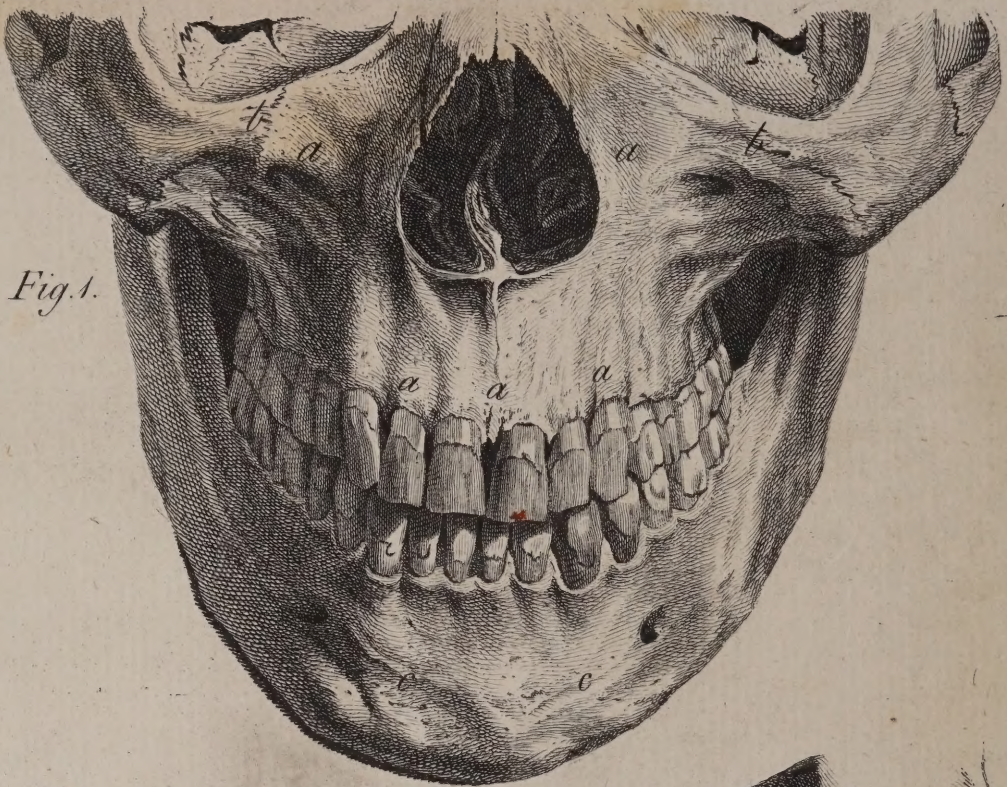
H The *Meatus Auditorius externus*.

I The hollow, or cavity in the temporal bone for the articulation of the Lower-Jaw.

K The eminence before that cavity, likewise for articulation.

L The moveable cartilage of the Joint.





P L A T E . III.

Fig. I. A front view of the Upper and Lower-Jaws of an adult, with a full set of Teeth.

aaaaa The Upper-Jaw.

bb Its attachment to the cheek-bones below the orbits.

cc The Lower-Jaw.

Fig. II. A side view of both Jaws in the same state.

AAAA The Upper-Jaw.

BB The body of the Lower-Jaw.

C Its ascending process.

D The Root of the Coronoid Process.

E The Condyle.

FFFF The fluted Alveolar Processes.

P L A T E IV.

Fig. I. The basis of the skull, and of the Upper-Jaw, with a full set of Teeth; shewing the cutting edges and grinding surfaces of the Teeth of the Upper-Jaw, and the cavity and eminence of the temporal bone for the articulation of the Lower-Jaw.

a a a a The four *Incisores*.

b b The two *Cuspidati*.

c c The four *Bicuspides*.

d d The six Grinders.

e e The two cavities in the temporal bones for the articulation of the condyles of the Lower-Jaw.

f f The two eminences upon which the condyles move, in many actions of that bone.

Fig. II. A view, from above and behind, of the Lower-Jaw, with a full set of Teeth; shewing the cutting edges and grinding surfaces of the Teeth in that Jaw, with the Coronoid Processes, and condyles for articulation.

a a a a The four *Incisores*.

b b The two *Cuspidati*.

c c The four *Bicuspides*.

d d The six Grinders.

e e The Coronoid Processes.

f f The Condyles.

Fig. III. The moveable cartilage of the joint of the Lower-Jaw.

a The cut surface of a longitudinal section of it. The lower and concave surface is what is articulated with the Condyle; the upper and convex surface is what is in contact with the Temporal Bone.

Fig. 1.



Fig. 2.

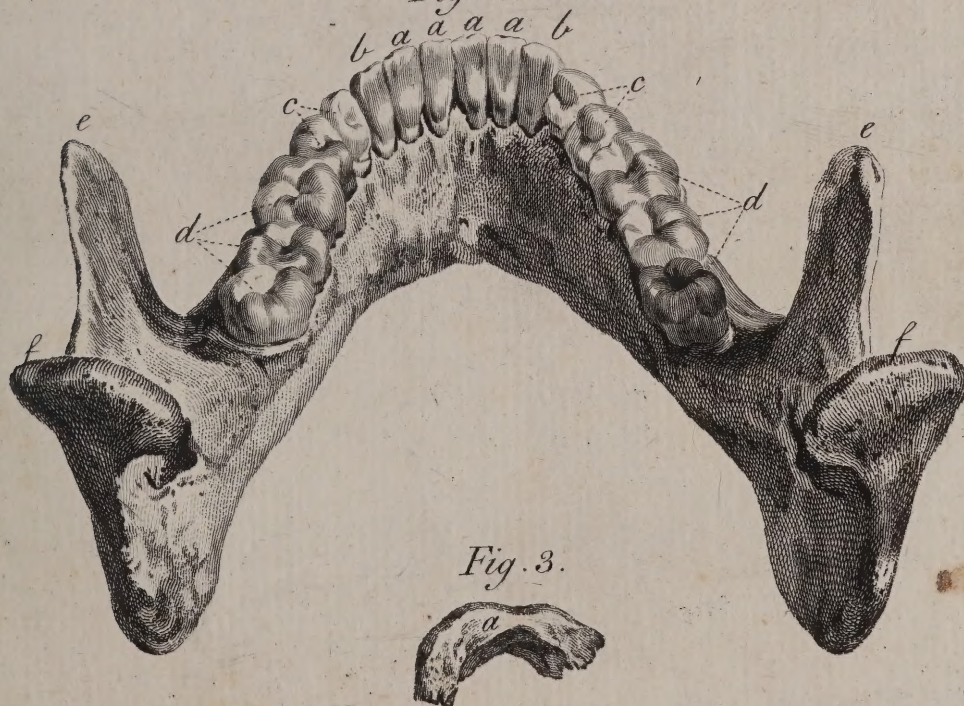
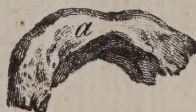


Fig. 3.



Row 1.



Row 2.



Row 3.



Row 4.



P L A T E V.

Two views of the sixteen Teeth of one side of both Jaws, taken out of their sockets to expose the whole of each Tooth.

Row 1. The Teeth of the Upper Jaw, seen from the outside.

Row 2. The same view of the Teeth of the Lower-Jaw: the five single are similar to those in the Upper-Jaw, but the Grinders in this have only two fangs.

a a The two *Incisors*.

b The *Cuspidatus*, shewing in the same view how much it is longer than the others.

c c The *Bicuspides*.

d d The two first Grinders, having three fangs.

e The third Grinder, or *Dens Sapientiæ* having also three fangs.

Row 3 and 4. A side view of the same Teeth, shewing that the *Incisores* and *Cuspidati* in this view differ from the former view more than the *Bicuspides* or Grinders.

Row 3, *a a* The two *Incisores* of the Upper-Jaw, shewing the hollowed inner surface of the body of those Teeth.

b The *Cuspidatus*, shewing the same.

c c The *Bicuspides*, shewing the two points on the basis of each. The first of them has a forked fang.

P L A T E VI.

Fig. I. A side view of the Upper and Lower-Jaw, in which the outer plate of the Alveolar Process was taken off to expose the Fangs of the Teeth in their sockets. The length of each fang is at once seen with respect to its neighbour, and this kind of articulation pointed out at one view.

Fig. II. A view of the inside of the Teeth of both Jaws in their natural situation when the mouth is shut. In this view the spectator's eye is supposed to be placed behind and below the two Jaws.

Fig. 1.

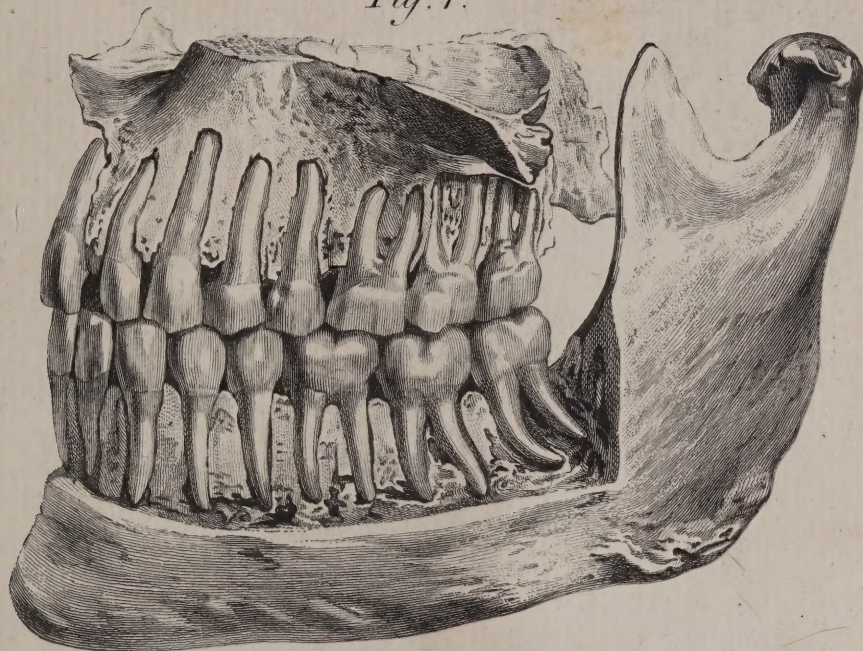
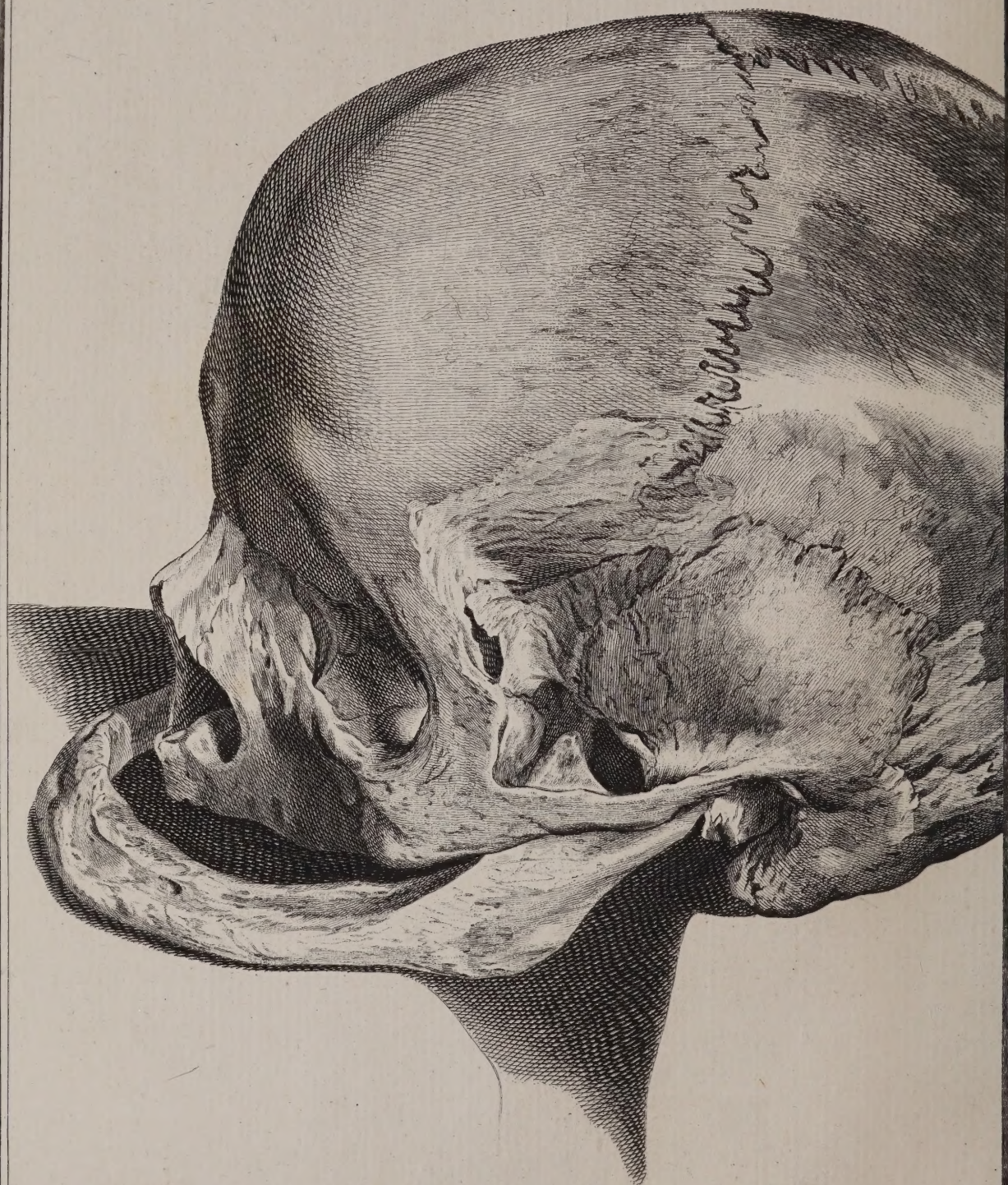


Fig. 2.





J. Van Riemsdyk fecit.

Published according to Act of Parliament May 15 1771. by I. Johnson.

J. Fongeror sculp.

P L A T E VII.

The bones of the head of a very old woman, who had lost her Teeth a considerable time before death. The whole Alveolar Processes are gone in both Jaws, which allows of the Lower-Jaw being raised about two Inches higher than what is common in shutting the mouth, before the gums of both Jaws can come into contact ; by this increased motion of the Lower-Jaw, the chin is brought more upon a line with the articulation, therefore projects beyond the Upper-Jaw considerably.

P L A T E VIII.

This plate shews the gradual growth of the two Jaws, especially of the Alveolar Processes.

Fig. I. and II. One side of the Lower and of the Upper-Jaw of a Foetus about three or four months old.

a a The groove which is afterwards formed into Sockets.

Fig. III. and IV. One side of the Lower and of the Upper-Jaw of a Foetus about six months old, at which age (*a a*) some of the partitions have shot across near the anterior part, forming distinct cells.

Fig. V. and VI. The Upper and Lower-Jaw of a new born child, shewing the last mentioned circumstance in a more advanced state.

Fig. VII. The Lower-Jaw of a child seven or eight months old, in which the two first *Incisores* had cut the gum, shewing the sockets of six Teeth.

a a The mouths of the Alveoli contracted over the Teeth, especially those of the Grinders, where they have not yet begun to open for the passage of the Teeth.

Fig. VIII. A sketch of an Upper-Jaw where the *Cuspidatus* of that side had been formed high up in the Jaw, and therefore never could appear through the Gum. *a* The fang of the *Cuspidatus*. *b* Its body contained in the Upper-Jaw and Alveolar Process.

Fig. IX. A sketch of the Upper-Jaw of a child, where the *Cuspidatus* was inverted, so that its point was turned up against the Jaw, and the growing mouth of its cavity towards the Gum. *a* The point of the *Cuspidatus* turned up against the Jaw. *b* The open and growing part of the Tooth which should be formed into a fang.

Fig. X. The out-line of the Lower-Jaw of a child, to shew that the Condyle is then nearly on a line with the Gums.



P L A T E I X.

Fig. I. The Teeth of one side of both Jaws, from a child of five or six years of age. BB, CC The temporary Teeth almost completely formed. AD, Seven, viz. four above and three below, of the succeeding Teeth seen at the roots of the first set. EE, The body of the first adult Grinder nearly formed.

Fig. II. The Teeth of one side of both Jaws, from a child of seven years of age. This is an age in which there are more Teeth formed and forming than at any other time of life. BB, CC, The ten temporary Teeth complete. AD, Ten incomplete to succeed them. EE, Two adult Grinders; making twenty-two in this side, and of course forty-four in the whole. *aaaa*, the Fangs of the temporary *Incisors* beginning to decay at their points.

Fig. IV. The five Teeth in the half of each Jaw of a Person of seven or eight months, showing the progress of ossification from the first Jaw to the second Grinder.

Fig. V. The same teeth somewhat farther advanced.

Fig. VI. The Teeth of a child of eight or nine years of age, showing the first temporary Teeth in a more advanced state, with the first adult Grinders. The adult Incisors and one Canine are also begun to be formed.

Fig. 1.



Fig. 2.



Fig. 1.

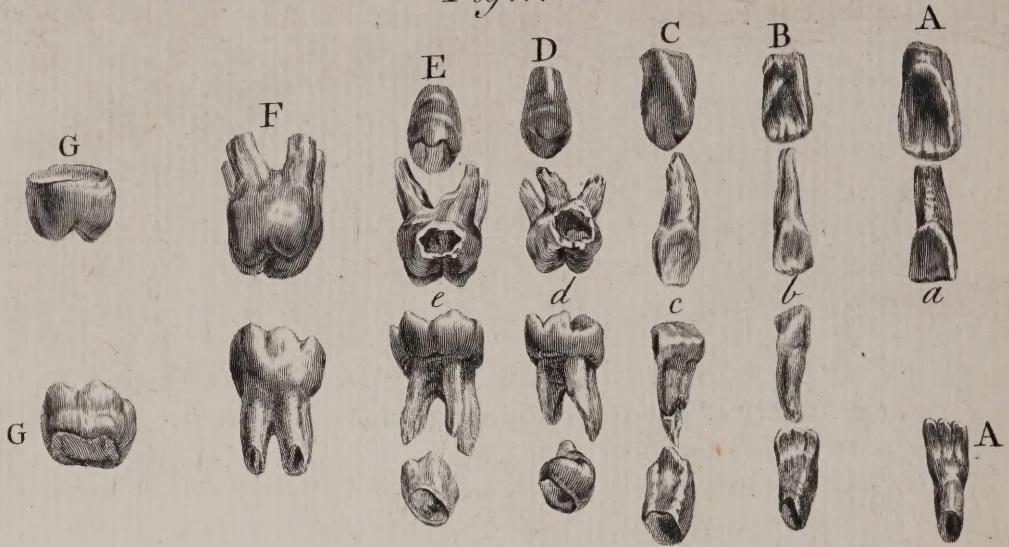


Fig. 2.

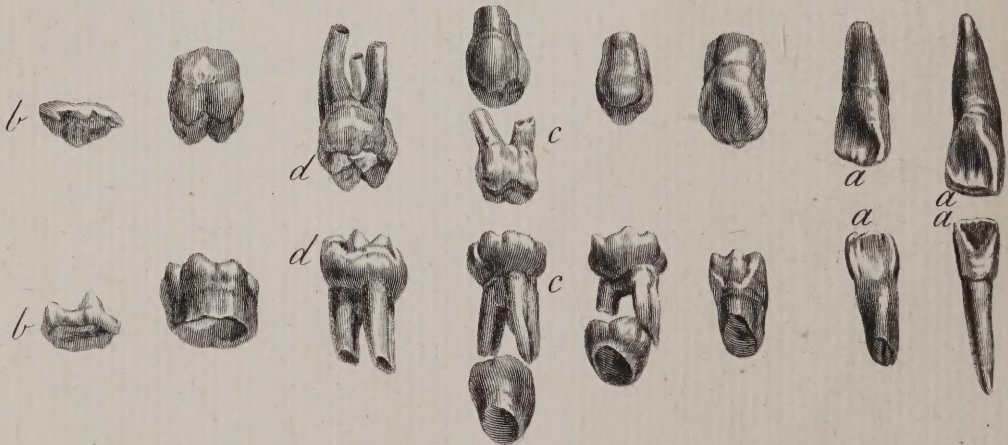


PLATE XI.

Fig. I. The Teeth of a child eight or nine years old; principally to shew the progress of the second Set, and the beginning and decay of the first Set.

A A, The first *Incisores* of the second or permanent Set. B. The second *Incisor*. C. The *Cuspidatus*. DE, The *Bicuspidates*. FG, The two first *Molares*.

a b, The temporary *Incisores*, the first of which in the lower Jaw is wanting, having been shed. c, The *Cuspidati*. d e, The temporary *Molares*.

Fig. II. The Teeth of a youth about eleven or twelve years old, shewing the farther progress of the one Set towards perfection, and of the other in their decay.

a a a a, The *Incisores* of the second Set, which had all cut the Gum. b b, The Basis of the third *Molaris* or *Dens Sapiientiæ*. c c, The remaining *Molares* of the first Set, with decayed Fangs. d d, The two first *Molares* of the second Set, so much advanced that they had cut the Gums.

P L A T E XII.

Fig. I. The Lower-Jaw of a Fœtus, from which part of the Gum and bony socket is taken off, to expose the membrane which incloses the Teeth. *a*, The upper edge of the gum. *b b b*, The membrane which covers the Teeth.

Fig. II. The Upper-Jaw of the same Fœtus, shewing the same membrane in that Jaw.

Fig. III. The Lower-Jaw of a new-born child, where this inclosing membrane is opened, to shew the bodies of the Teeth that were covered by it. The blood vessels which run in its substance are also exposed.

a, The body of the Tooth. *b*, The membrane.

Fig. IV. That part of the Jaw and Gum which contains the *Cuspidatus*. The whole is a little magnified. The membrane is opened and turned off on each side, and the fore part is turned down. The upper part of the pulp is covered with its bony shell, which is seen by its want of vessels.

a, The ossified part of the Tooth. *b*, The pulp. *c c*, The membrane opened and turned back.

Fig. V. and VI. Two pulps magnified. Fig. V. The pulp of the *Cuspidatus*, Fig. VI. That of the Grinder. The ossifications are removed, to shew that the pulp is of the same shape with the Tooth which is formed upon it. As far down on the pulp as the vessels are seen, the ossification had advanced; which shews that it is more vascular where the operation of ossification is going on. The lower ragged edge, *a*, is part of the capsula turned down.

Fig. 7. One of the Grinders of the Lower-Jaw, sawed down to expose the two cavities or canals leading to the body of the Tooth, where they unite, and form a square cavity. In these two canals are seen two arteries, which run on to the common cavity, and there ramify. The veins are not injected. The whole is magnified.

In the body of the Tooth may be observed a number of strata, each of which is lost in the circumference of the Tooth.

a a, The Jaw-bone and Gum cut through. *b*, The body of the Tooth. *c c*, The two fangs. *d d*, The arteries running into the cavities of the fangs.

Fig. VIII. An *Incisor* prepared and magnified in the same manner, shewing the same circumstances in that Tooth.

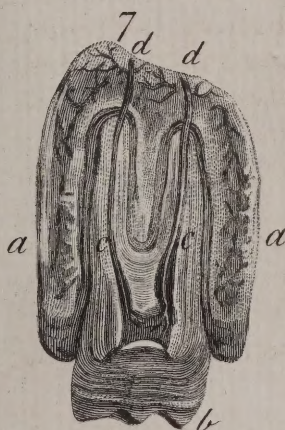


Fig. 1.



Fig. 2.



Fig. 3.



P L A T E XIII.

Fig. I. Shews the formation of the cavity and fangs of the Molares. The upper row are those of the Lower-Jaw, and the lower those of the Upper. A A, *a a*, is the common cavity in the body of the Tooth, which in the 2d, *a a*, is deeper than in the first. B shews the bony arch thrown over the mouth of the cavity, and dividing that into two openings which give origin to the two fangs. C D E, The progress of these fangs. F, a *Molaris* of the Upper-Jaw, where the mouth of the cavity is a little tucked in, at three different points, from which three ossifications shoot. G shews these ossifications, and the beginning of three fangs. H I K, shews the gradual growth of these fangs.

Fig. II. Is a comparative view of the Incisors and Grinders of the child and adult; for the better understanding of which they are sawed down the middle, shewing in a side view the gradual increase of these Teeth. The uppermost row is of the child, and the lower of the adult. *a b c d*, Shew the gradual growth of the body, fangs, and cavity of the of *Incisors* both ages. *e f g*, Shew these circumstances in the Grinders.

Fig. III. 1, 2, 3, 4, 5, 6, 7, shewing the gradual growth of a single Tooth, from its first formation nearly, to its being almost complete.

P L A T E XIV.

Fig. I. II. III. IV. V. and VI. Shew the cavities of the Teeth in the *Insiores*, *Cuspidatus*, *Bicuspidatus*, and *Molares*.

Fig. VII. A *Molaris* of the Lower-Jaw, with part of its fangs sawed off, to shew that the sides of the cavity or canal have grown together, and divided it into two small canals, which are represented by the two dark points.

Fig. VIII. and IX. The cavity in the body of the Teeth seen in transverse sections.

Fig. X. and XI. Longitudinal sections of the *Molares* to expose the cavities.

Fig. XII. The basis of a *Molaris* whose points were worn down, and the bony part which projected into those points exposed.

Fig. XIII. A *Molaris*, whose bony part is wholly exposed, and only a circle of Enamel left covering the sides all round.

Fig. XIV. and XV. A lateral view of the Enamel of a *Molaris* and a *Bicuspis* cut longitudinally.

Fig. XVI. A *Cuspidatus* worn so much down, as to expose the whole end of the bony part, a circle only of Enamel remaining.

Fig. XVII. An *Incisor* slit down its axis, to shew the Enamel upon the body of the Tooth, covering much more of the convex than of the concave part.

Fig. XVIII. An *Incisor*, shewing the same as Fig. XVI.

Fig. XIX. A horse's Tooth slit down its whole length, to shew how the Enamel is intermixed with the bony part, and that it passes through the whole length of the Tooth. The Enamel is represented by the white lines, which are peniform, shewing the striated texture of the Enamel.

Fig. XX. The grinding surface of a horse's *Molaris*, to shew the irregular course of the Enamel.

Fig. XXI. An *Incisor* a little magnified, slit down its middle, to shew that the Enamel is striated, and that the *Striae* are all turned towards the centre.

Fig. XXII. A Grinder in the same state, to shew the same circumstances.

Fig. XXIII. The basis of a *Molaris* broken through, shewing that the Enamel is striated in this view also, and that all the *Striae* point to the centre. N. B. The Teeth must be broken to shew these facts.

Fig. XXIV. An old Tooth, whose basis has been worn down below the original termination of the cavity in the body of the Tooth, and that end has been filled up, in the same proportion, with new matter, to prevent the cavity being exposed. This matter is of a darker colour, as represented in the figure.

Fig. XXV. Another Tooth in the same state.

Fig. 1.

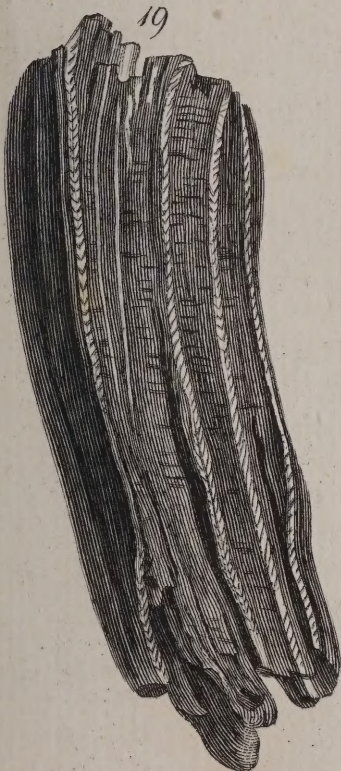
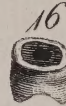


Fig. 1.



Fig. 2.



Fig. 3.

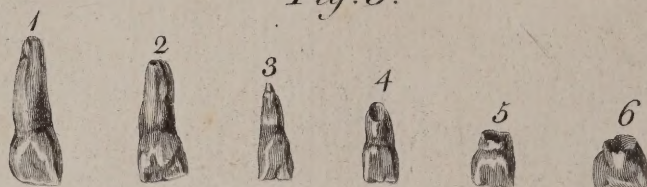


Fig. I. A horfe's Tooth that was juſt ready to be ſhed. The three parts of the Tooth which ſtand up *a a a* incloſed the riſing end of the young Tooth. This is all that was left of a long Tooth.

Fig. II. A ſeries of Grinders of the child, from their being complete to their utmoſt decay. *a* is a Grinder of the Upper-Jaw nearly complete, in which the three fangs are almoſt formed. *b* has ſome of its fang abſorbed, *c* more, *d* ſtill more, *e* nearly all gone, and *f* the whole of the fangs gone, only the neck and body remaining.

Fig. III. A ſeries of *Incifoſes* in the ſame ſtate. No. 1. A complete formed Tooth. 2. The fang ſomewhat decayed. 3. More ſo. 4. Still more. 5. The fang almoſt gone: and, 6. the whole fang gone, the neck and body only remaining.

Fig. I. The outlines of a Lower-Jaw, in which one or two Grinders have been lost out of the space *a*, and where the bodies of the two adjacent Teeth, *b c*, have approached one another, by the pressure which has been applied to their basis in mastication, from the want of their support on that side: we see also the waste of the *Alveoli* which belonged to the lost Teeth.

Fig. II. Four Lower-Jaws at different periods of life, from the age when the five shedding Teeth are completely formed, to that of a complete set. This figure shews four things: 1. The lengthening of the Jaw backwards, which is seen by the oblique line made by the four condyles: 2. The gradual rise of the two processes above the line of the Teeth: 3. The gradual increase of the Teeth in proportion as the Jaw lengthens: And fourthly, the part formed, always keeping of the same size. *a a a a* The Condyles. *b b b b* The Coronoide Processes. *c* The *Alveolus*, in which the Grinder of the Adult is forming. *d d d* The first Grinders formed. *e e* The *Alveoli* for the formation of the second Grinder. *f f* These completely formed. *g g* The *Alveoli* for the third Grinder. *h* That Grinder formed.

The two lines *i k* and *i m* mark the distance between the symphysis of the chin and sixth Tooth; they are parallel, or nearly so: it is impossible that there should be a mathematical exactness in four different Jaws. The line *il* separates the *Incisores* and *Cuspidatus* from the *Molares* in the child, and the *Bicuspidates* in the adult. This line is oblique, and the distances between the two ends of the two lines, *i k* and *il*, at *i i*, is nearly the same with the distance between the ends of the two lines *il*, and *i m*, at *l m*.

Fig. 1.

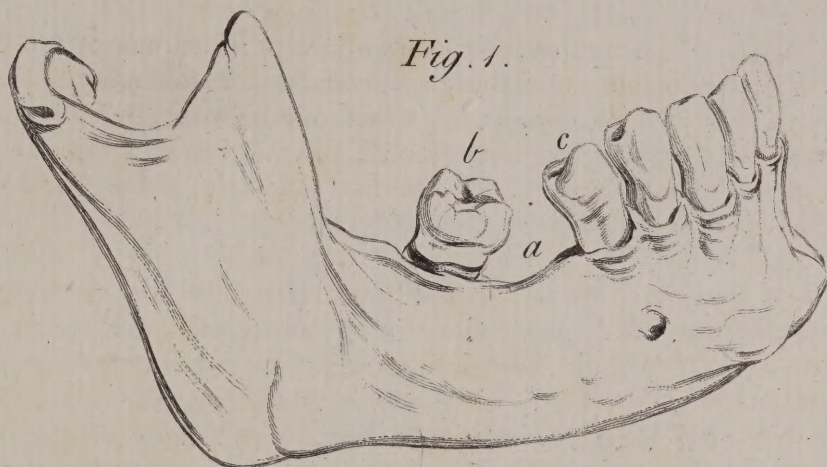


Fig. 2.







